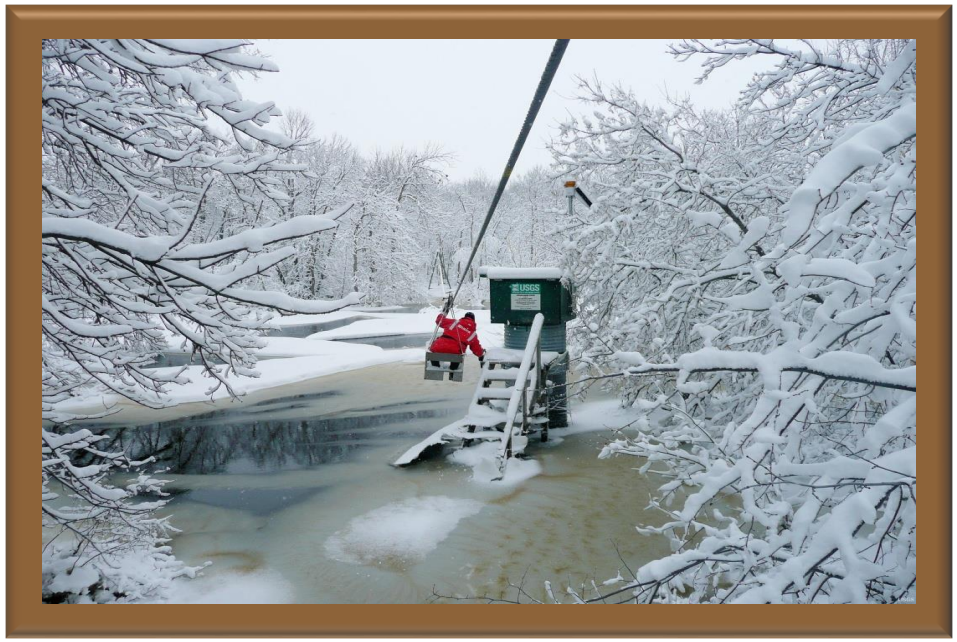
USFS National Flow Gage

Gap Analysis - Region 9



Roseau River near Malung, Minnesota

Prepared by
Dona Horan, Dan Isaak, Charlie Luce, RMRS
January 2014

Commissioned by
Chris Carlson, Katherine Smith, WO

Introduction

The purpose of this study is to review the location of stream gages across the region that are located on, or near, US National Forest System (NFS) lands, and to determine where there are gaps in the distribution of gages across the region.

Questions answered by this analysis include:

- What proportion of the lands in Region 9 are NFS lands?
- What is the extent of the stream network in the region?
- Where are the operational stream gages?
- Where have gages been discontinued?

Data presented in these slides were obtained from the following:

- **Streams:** stream layers (1:100K) were downloaded from the NHDPlus website: http://www.horizon-systems.com/nhdplus/data.php

- **Gages:** 5,473 stream gage locations were downloaded from the USGS website: http://waterservices.usgs.gov/rest/Site-Test-Tool.html

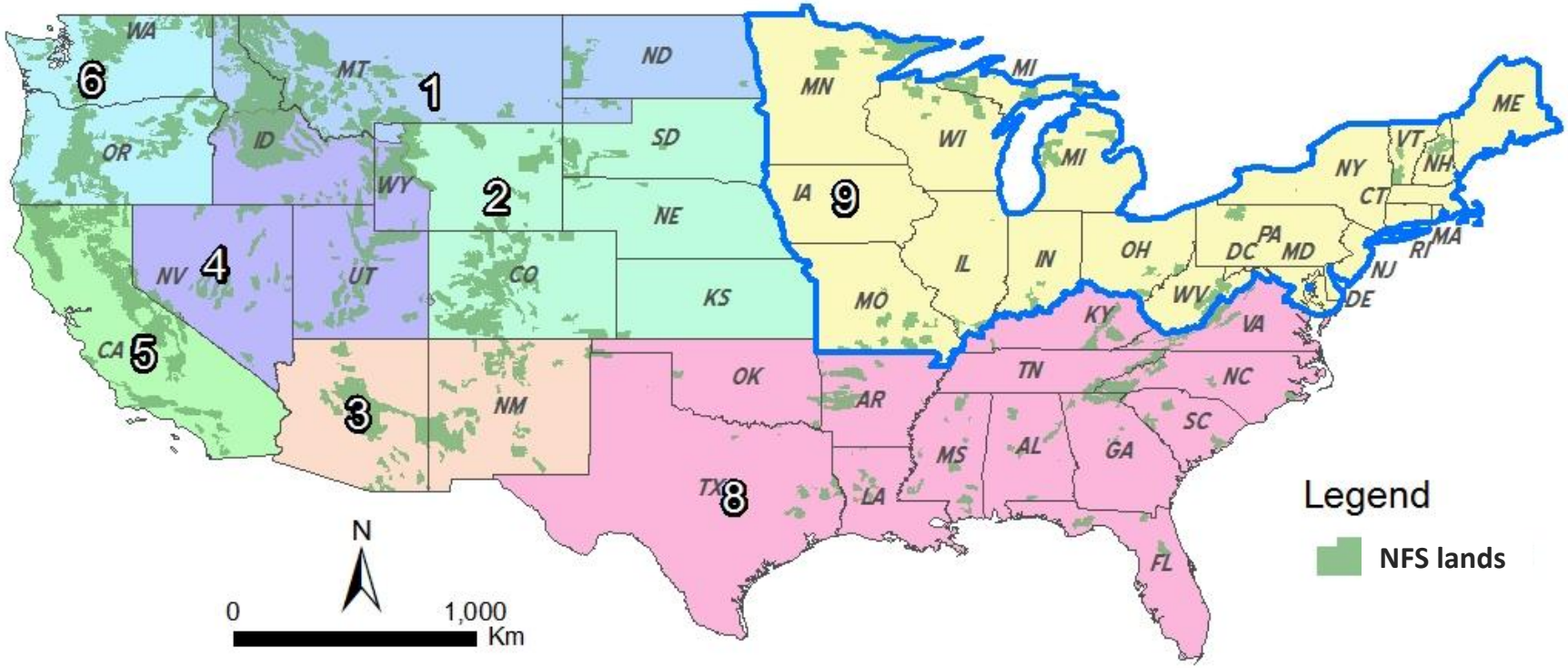
A note about the gage data:

Gage data were downloaded in spring 2012. We assumed that gages having no data beyond 12/31/09 were inactive and were labeled "Historic" in this analysis. Gages that had data past 1/1/10 were considered "Current" in the event their data had not yet been added to the website.

Summary Data

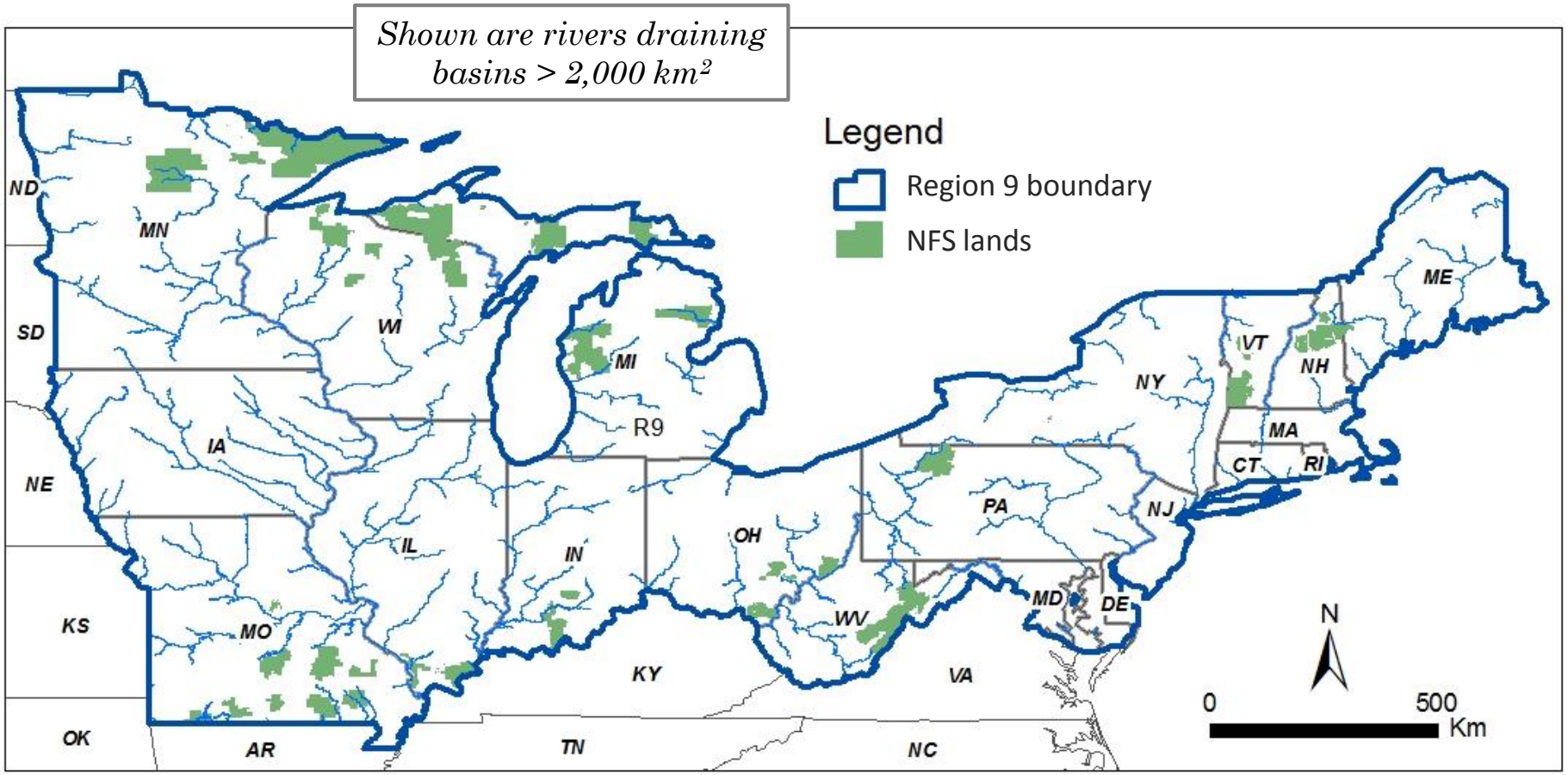
Attribute	On NFS lands in Region 9	All of Region 9	% NFS vs. Region 9
Land Area (Km^2)	86,389	1,712,404	5.0
Stream Length (km) (for basins > 4 km^2)	35,190	771,915	4.6
Number of Historic Gages	69	2,968	2.3
Number of Current Gages	63	2,505	2.5

USFS Regions in Lower 48



	NFS lands in R9	All lands in R9	% NFS lands in R9
Area (km^2)	86,389	1,712,404	5.0

River Network in Region 9



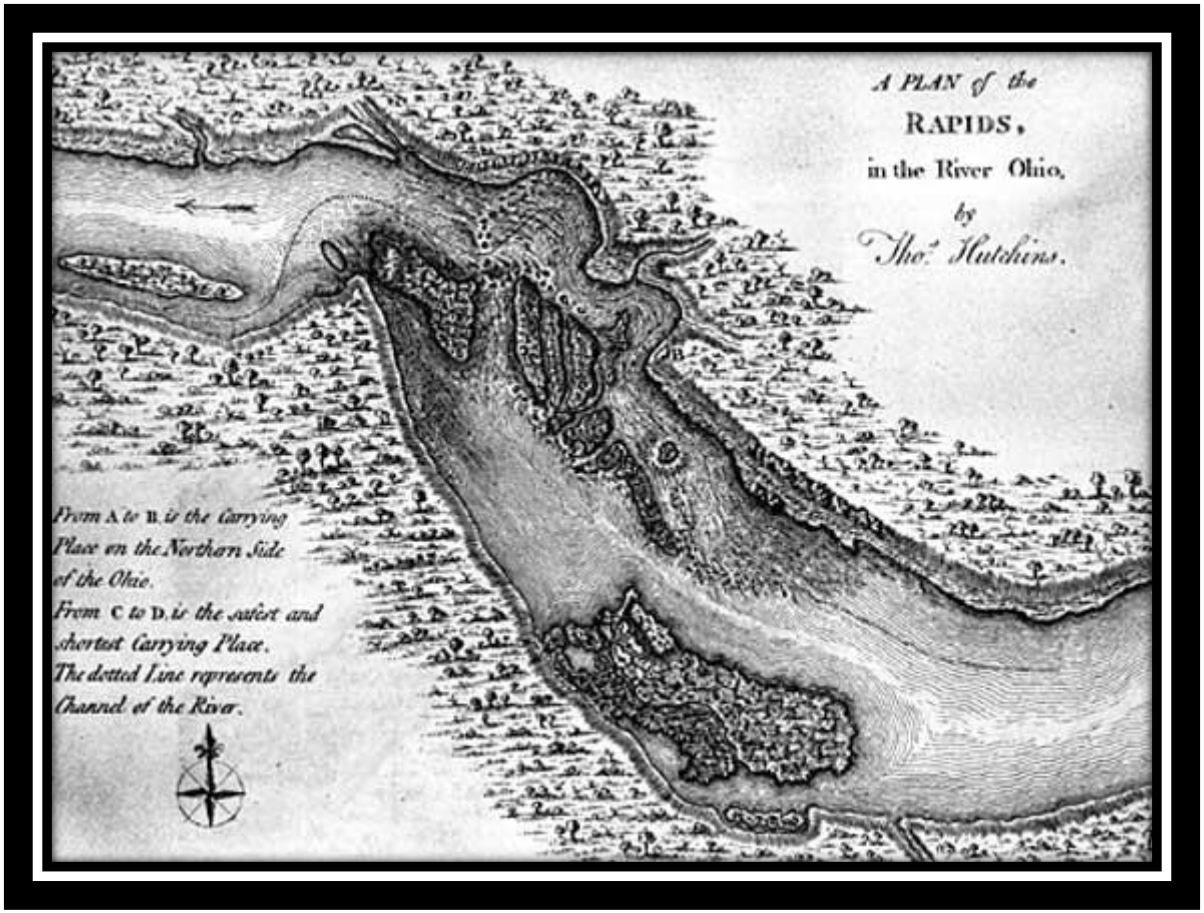
	NFS streams in R9	All streams in R9	% NFS streams in R9
Stream Length (km) (for basins > 4 km²)	35,190	771,915	4.6

The following slides show
the location of

USGS gages

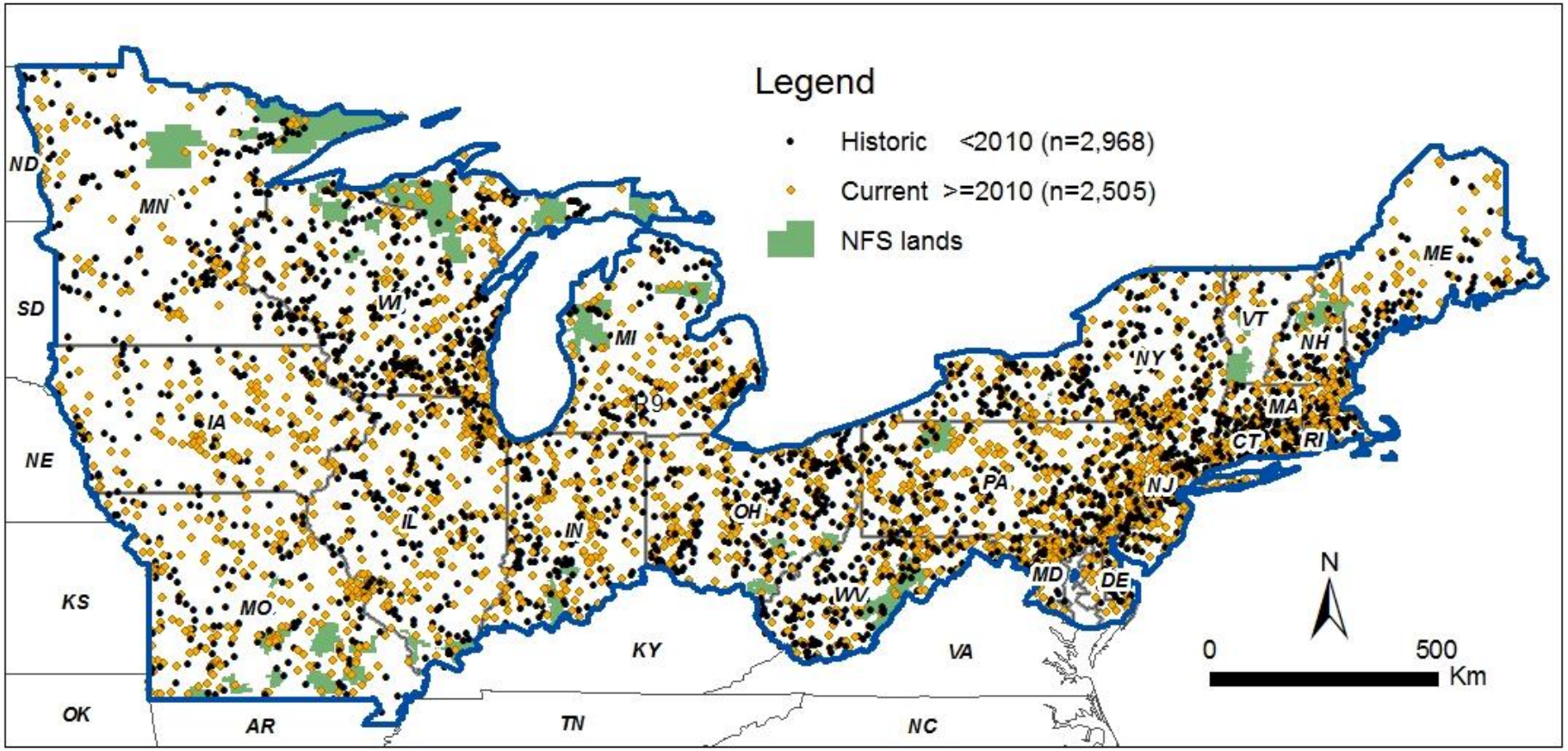
having discharge data collected from

1912 - 2012



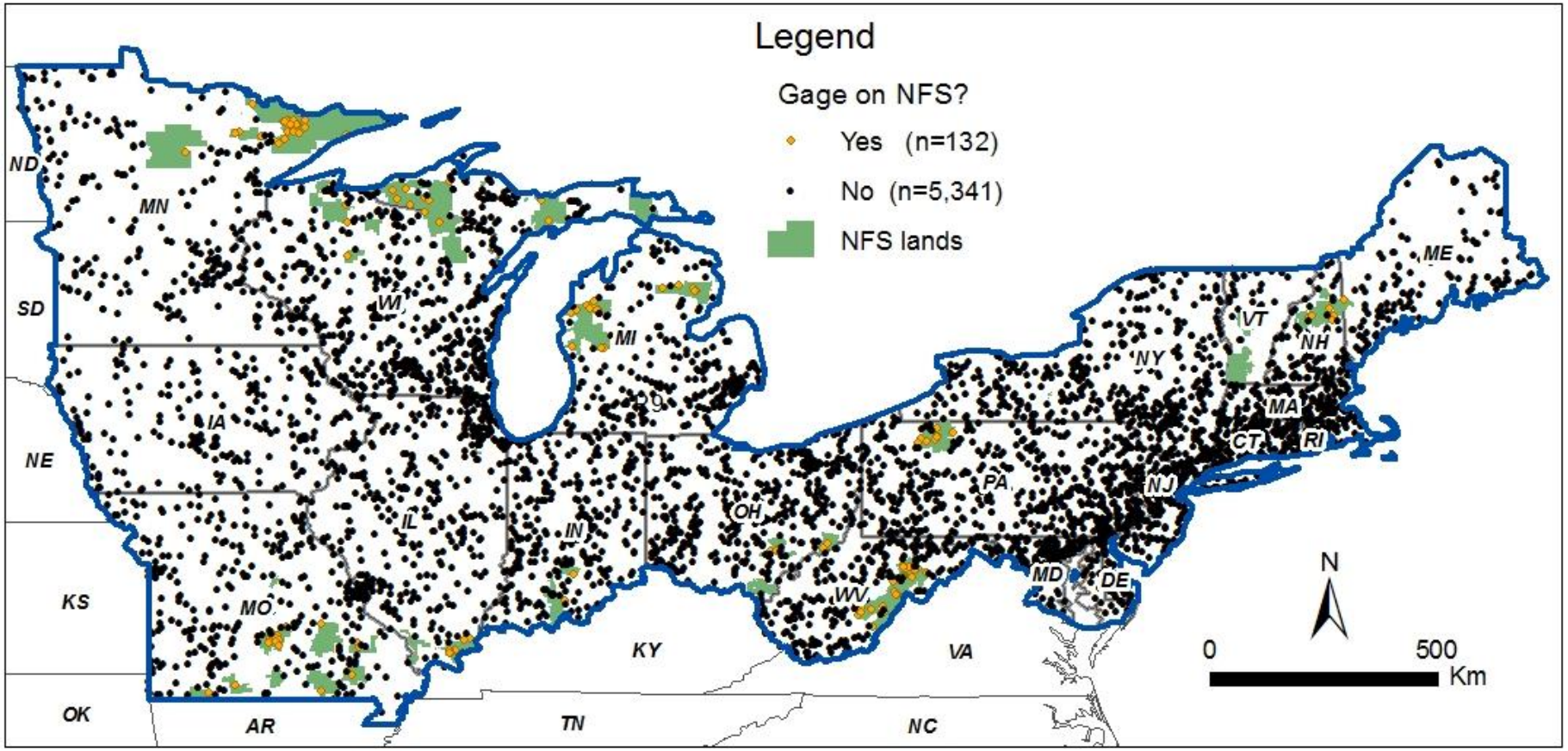
Early map of the falls of the Ohio River, site of Louisville, KY
Library of Congress, Washington, D.C.

Historic and Current USGS Stream Gages from 1912 – 2012 (n=5,473)



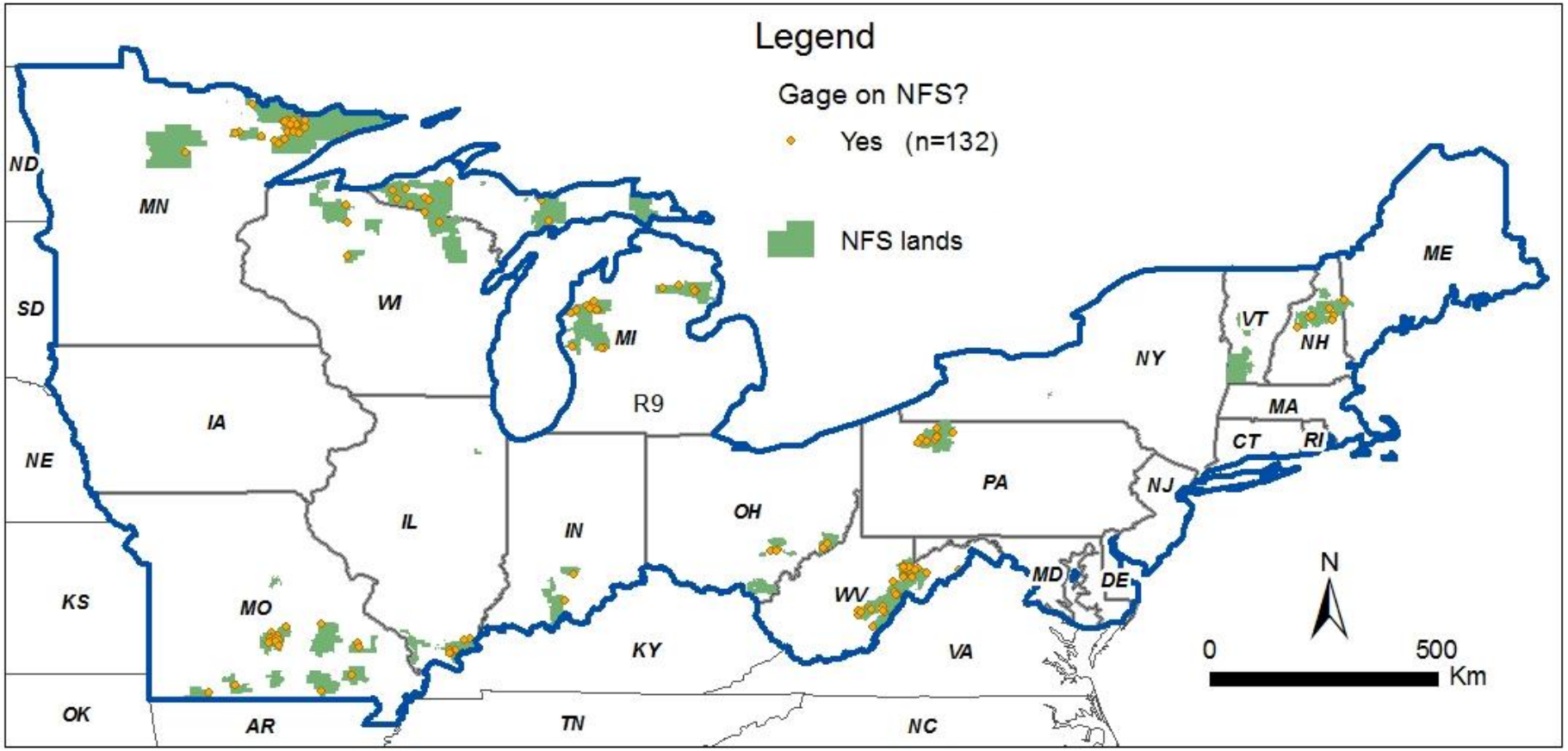
	Gages on NFS lands in R9	All gages in R9	% Gages on NFS lands in R9
Historic Gages	69	2,968	2.3
Current Gages	63	2,505	2.5

USGS Stream Gages from 1912 – 2012: Identifying those off and on NFS Lands



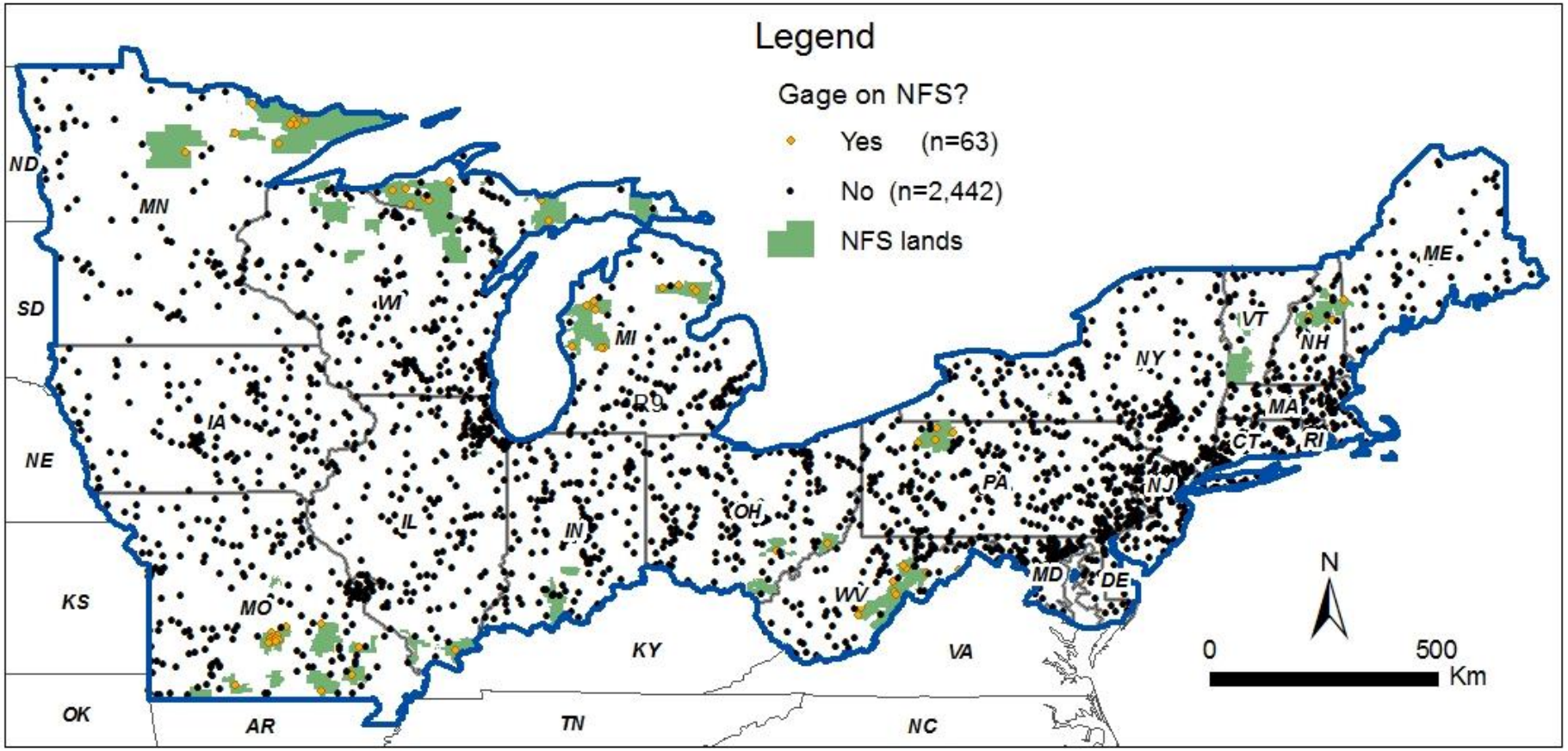
	Gages on NFS lands in R9	All gages in R9	% Gages on NFS lands in R9
Gages	132	5,473	2.4

USGS Stream Gages from 1912 – 2012: Only those on NFS Lands



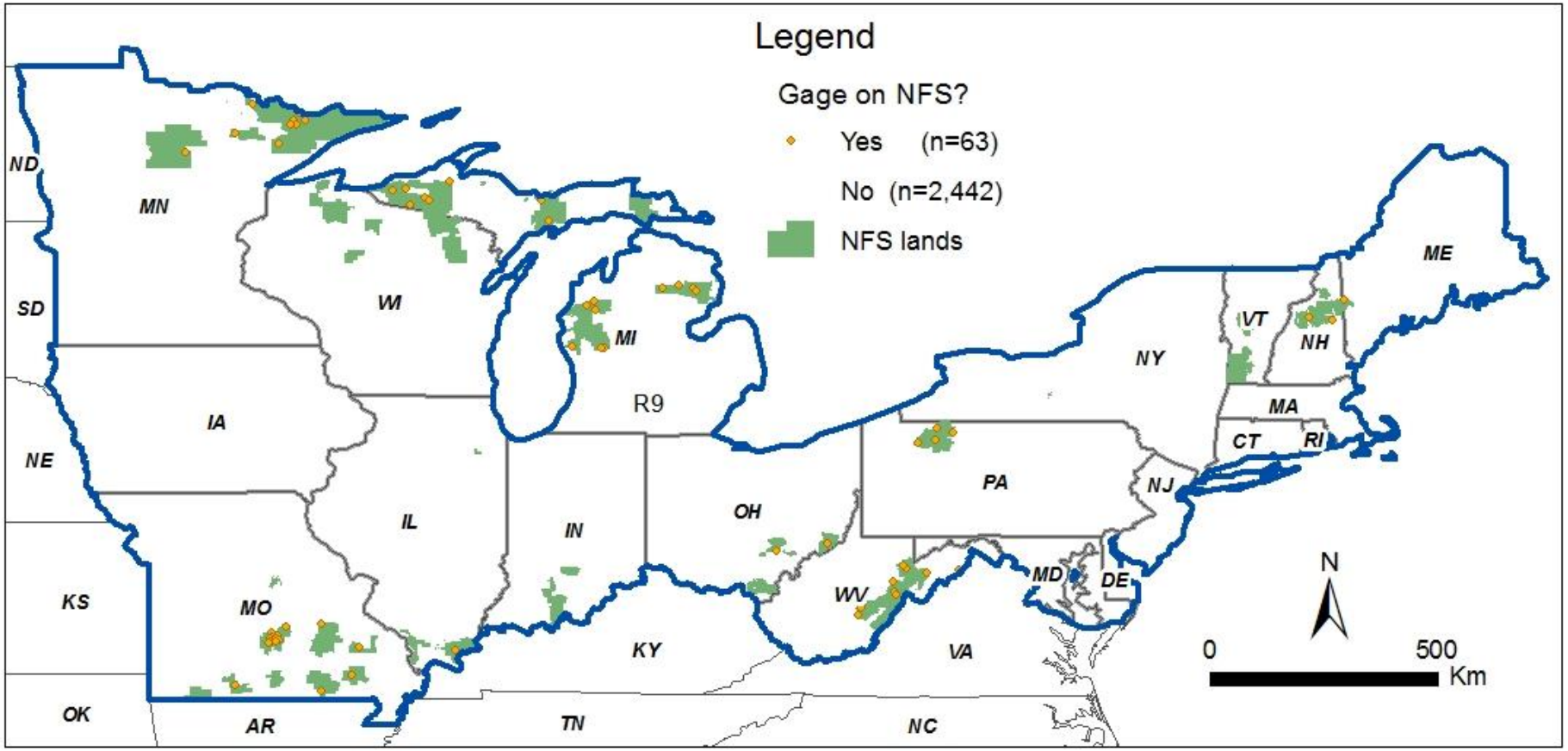
	Gages on NFS lands in R9	All gages in R9	% Gages on NFS lands in R9
Gages	132	5,473	2.4

USGS Stream Gages Currently Operational: Identifying those off and on NFS Lands



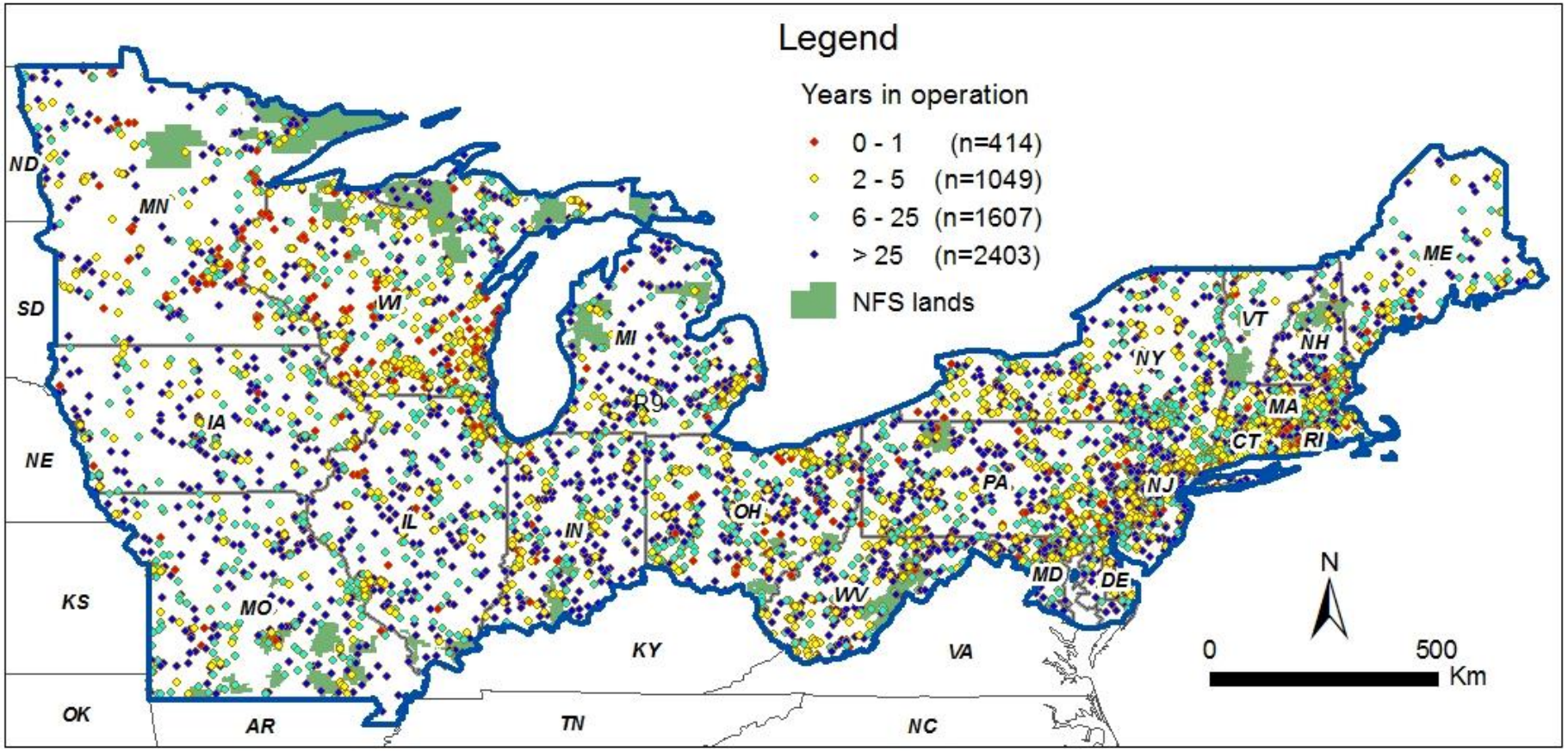
	Gages on NFS lands in R9	All gages in R9	% Gages on NFS lands in R9
Current Gages	63	2,505	2.5

USGS Stream Gages Currently Operational: Only those on NFS Lands



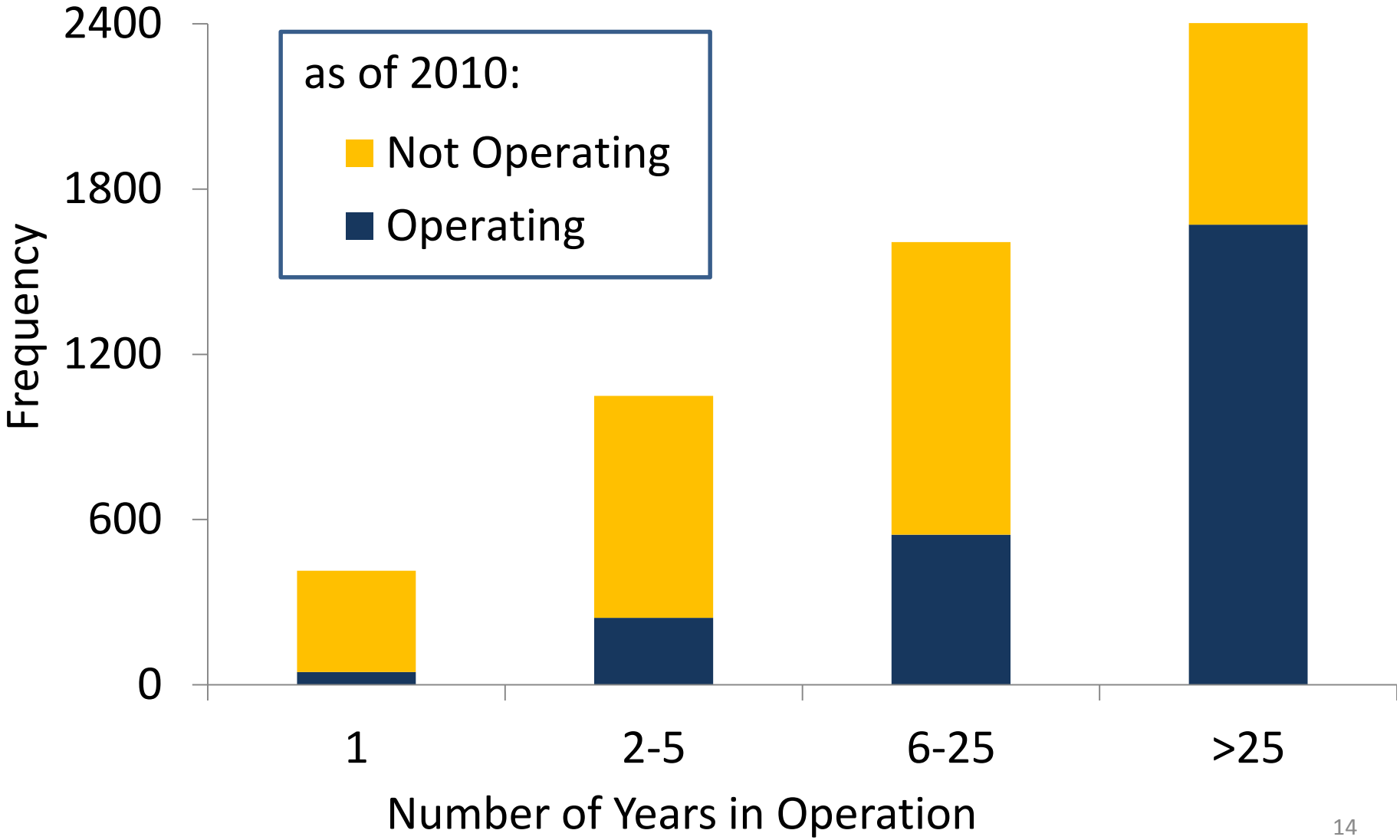
	Gages on NFS lands in R9	All gages in R9	% Gages on NFS lands in R9
Current Gages	63	2,505	2.5

Years in Operation
USGS Stream Gages from 1912 – 2012 (n=5,473)

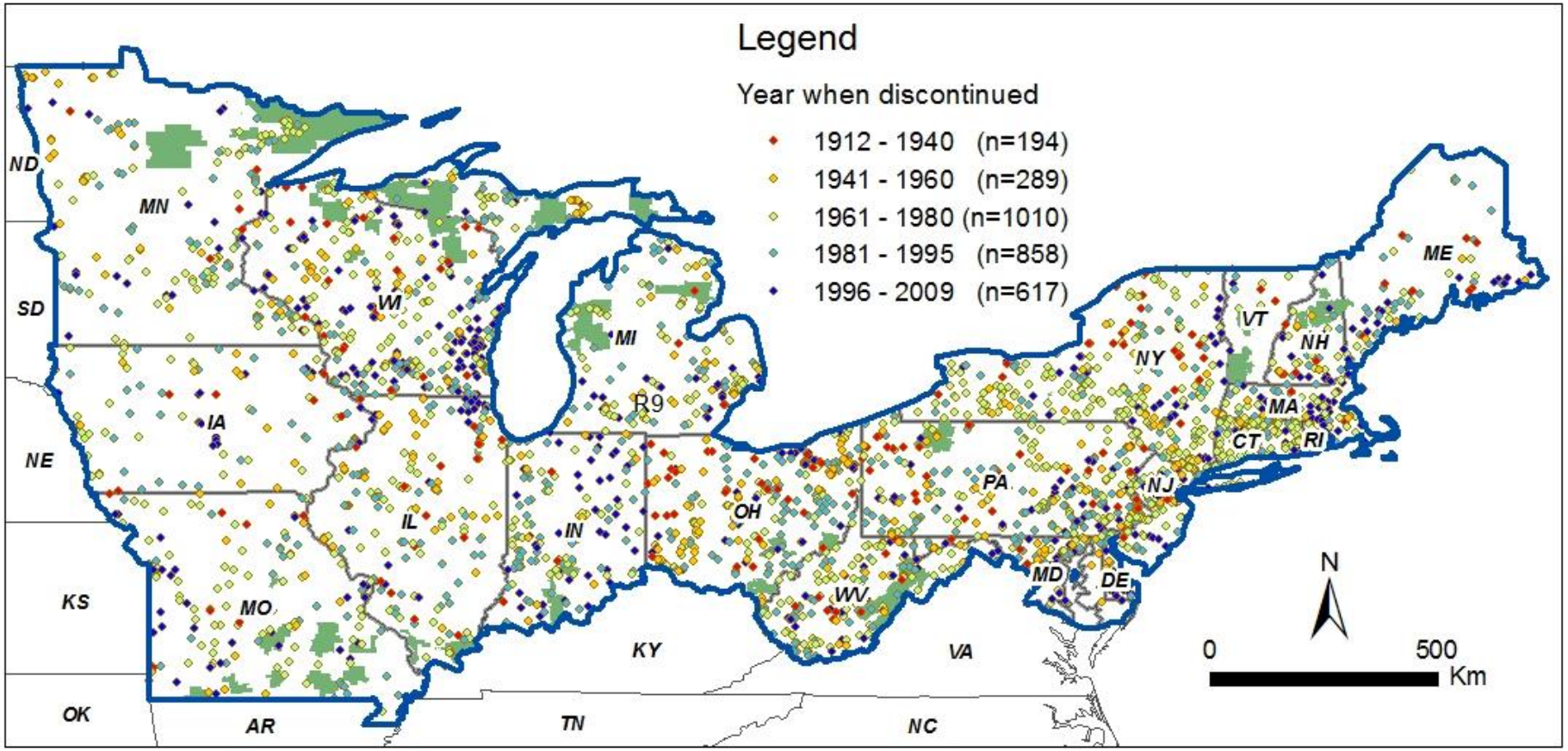


The next slide displays these data in a bar chart.

Years in Operation
USGS Stream Gages from 1912 – 2012 (n=5,473)



Year when Discontinued
USGS Stream Gages from 1912 – 2009 (n=2,968)



Group 1

Stream Segments in Region 9

On the following 3 slides, each stream segment within Region 9 is plotted by elevation and drainage area.

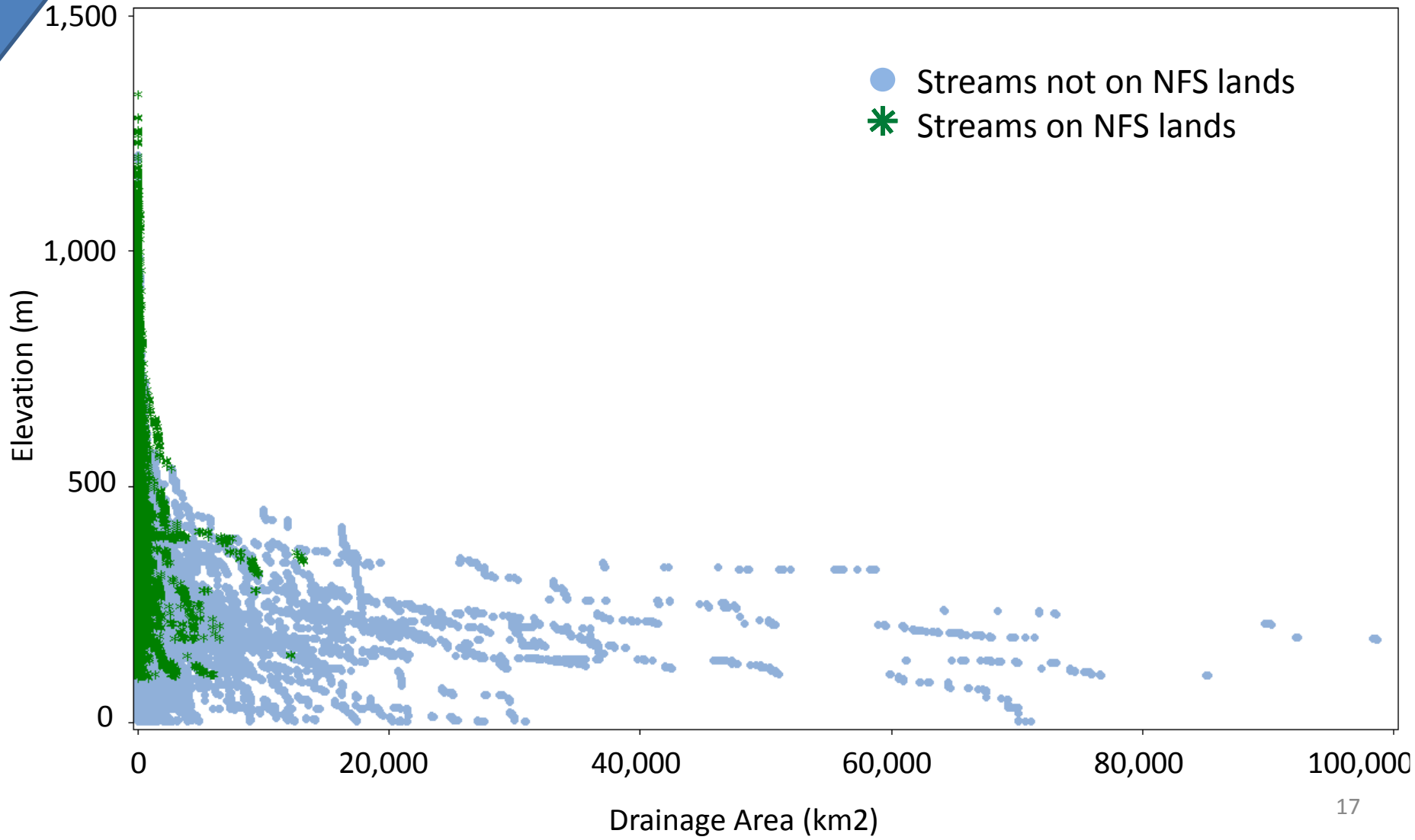
Overlaid on the region's stream segments are the stream segments located on NFS lands.

The first slide is truncated at 100,000 km^2 because the Ohio, Missouri, and Mississippi Rivers created a dramatically skewed plot.

The only difference between the next few slides is that for each successive slide the horizontal axis will be magnified.

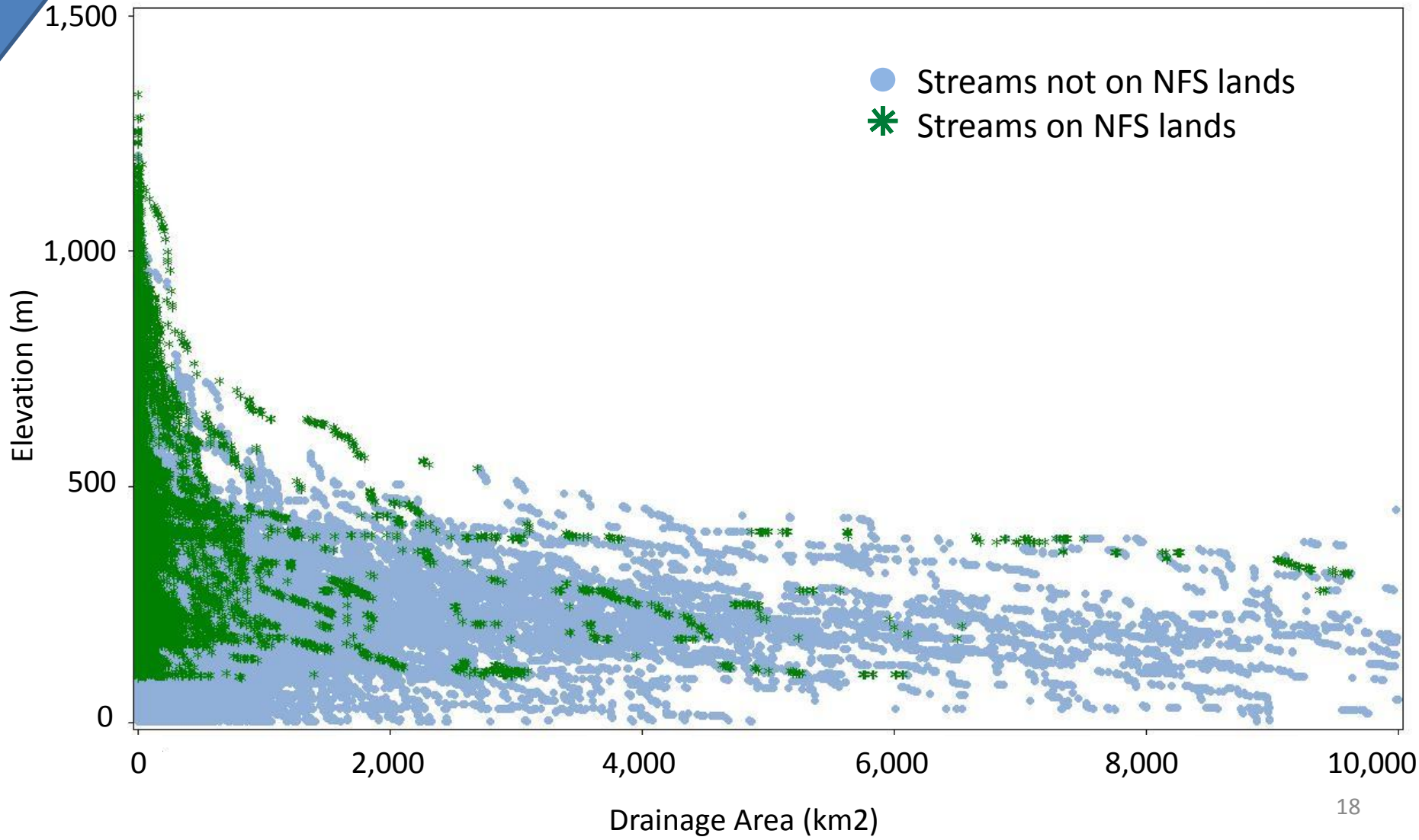
Group 1

Stream Segments in Region 9



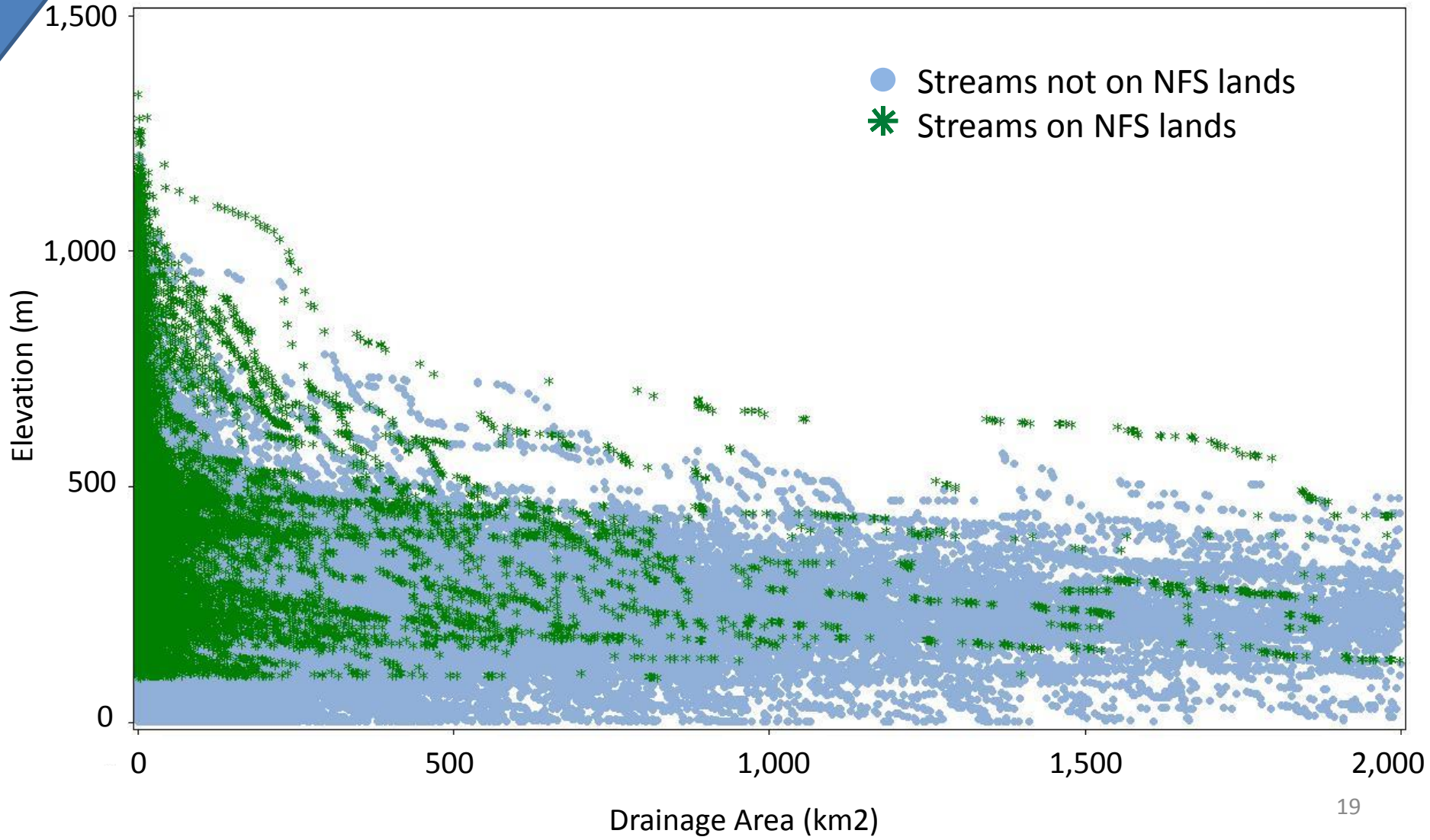
Group 1

Stream Segments in Region 9



Group 1

Stream Segments in Region 9



Group 2

Group 2

All Stream Gages – off and on NFS Lands

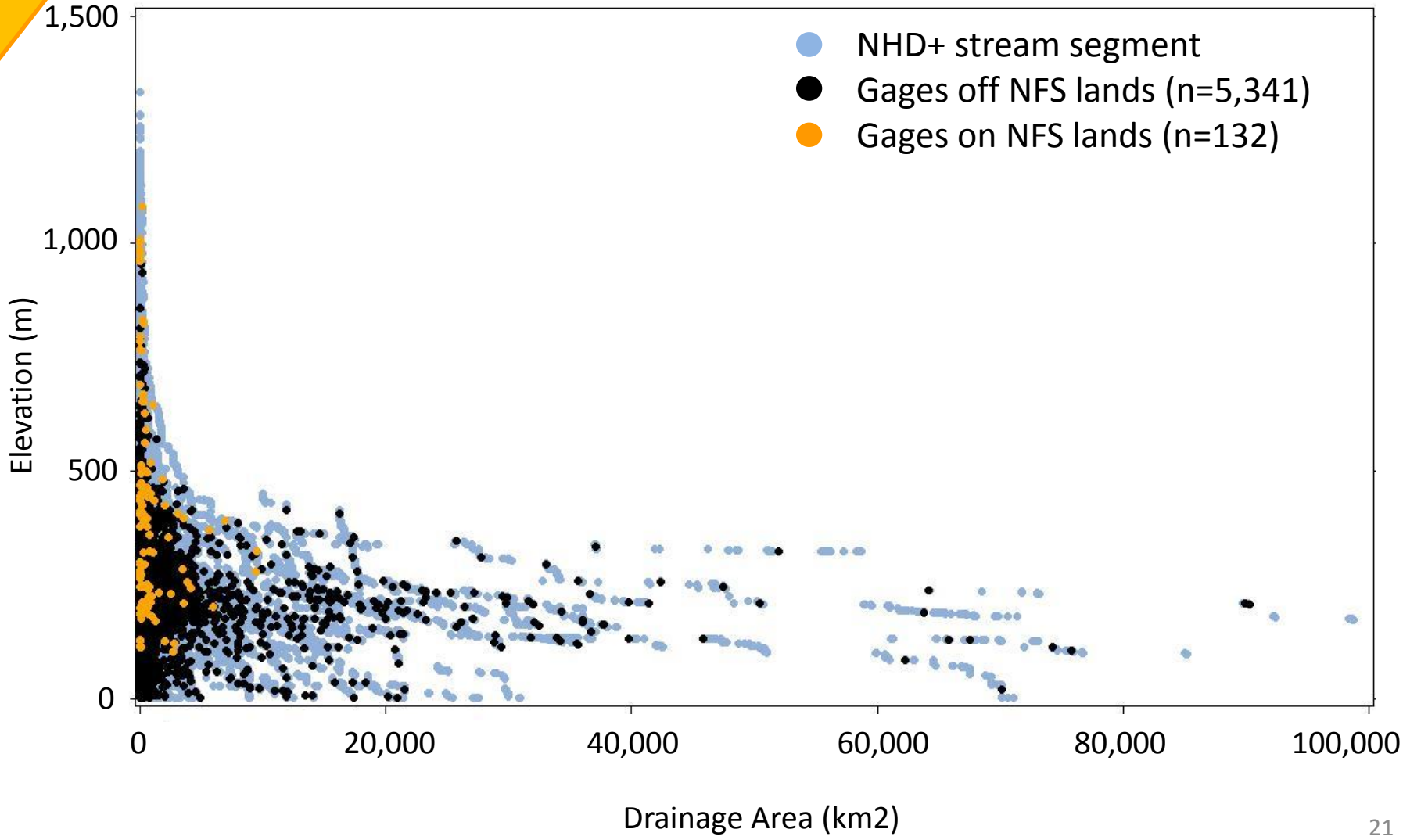
On the following 4 slides, each stream segment within Region 9 is plotted by elevation and drainage area (truncated at 100,000 km^2).

Overlaid on the stream segments are the 5,473 stream gages that are/were active since 1912. There are 5,341 gages that are not on NFS lands and 132 gages on NFS lands.

The only difference between the next few slides is that for each successive slide the horizontal axis will be magnified, as in Group 1.

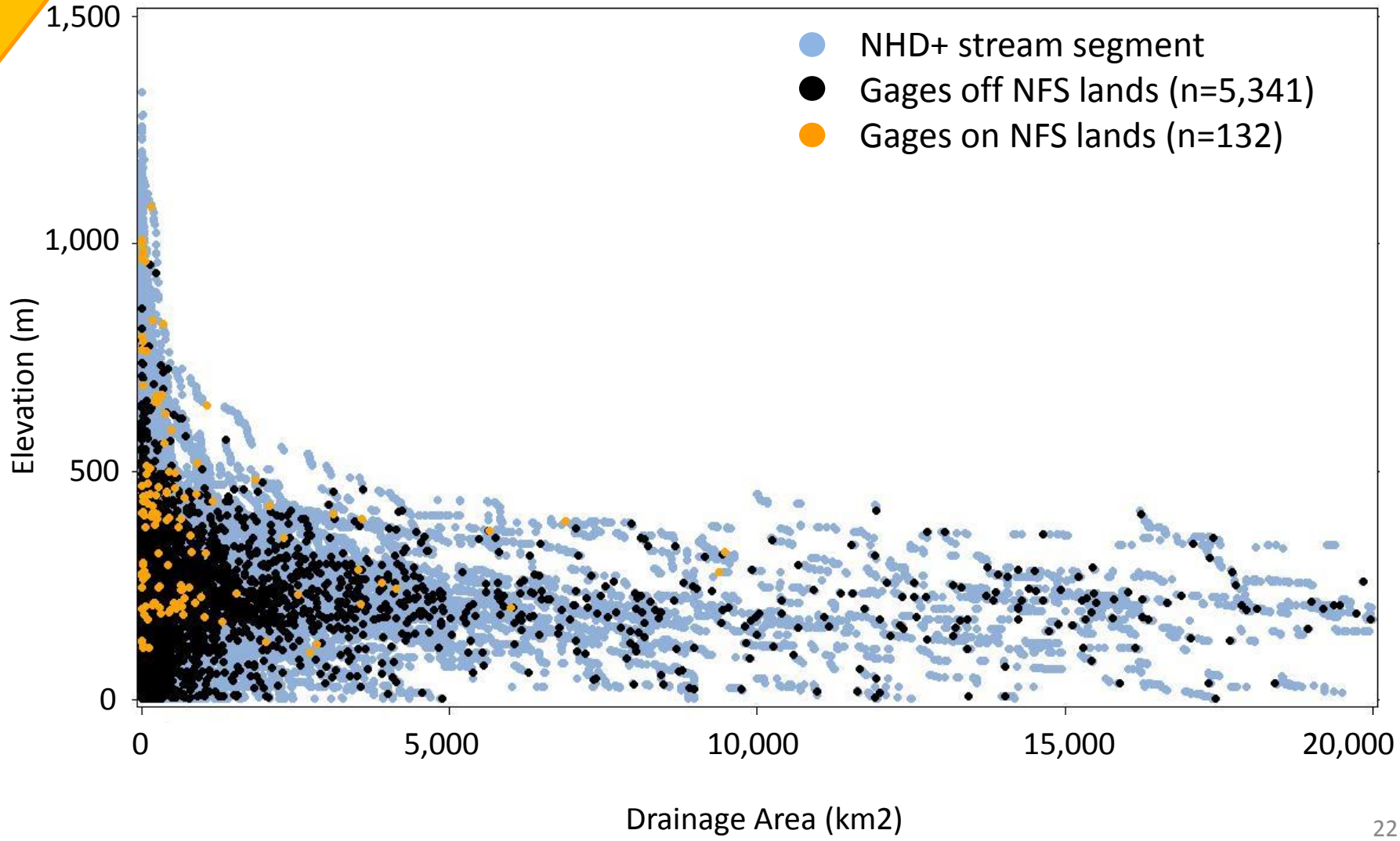
Group 2

All Stream Gages – off and on NFS Lands



Group 2

All Stream Gages – off and on NFS Lands



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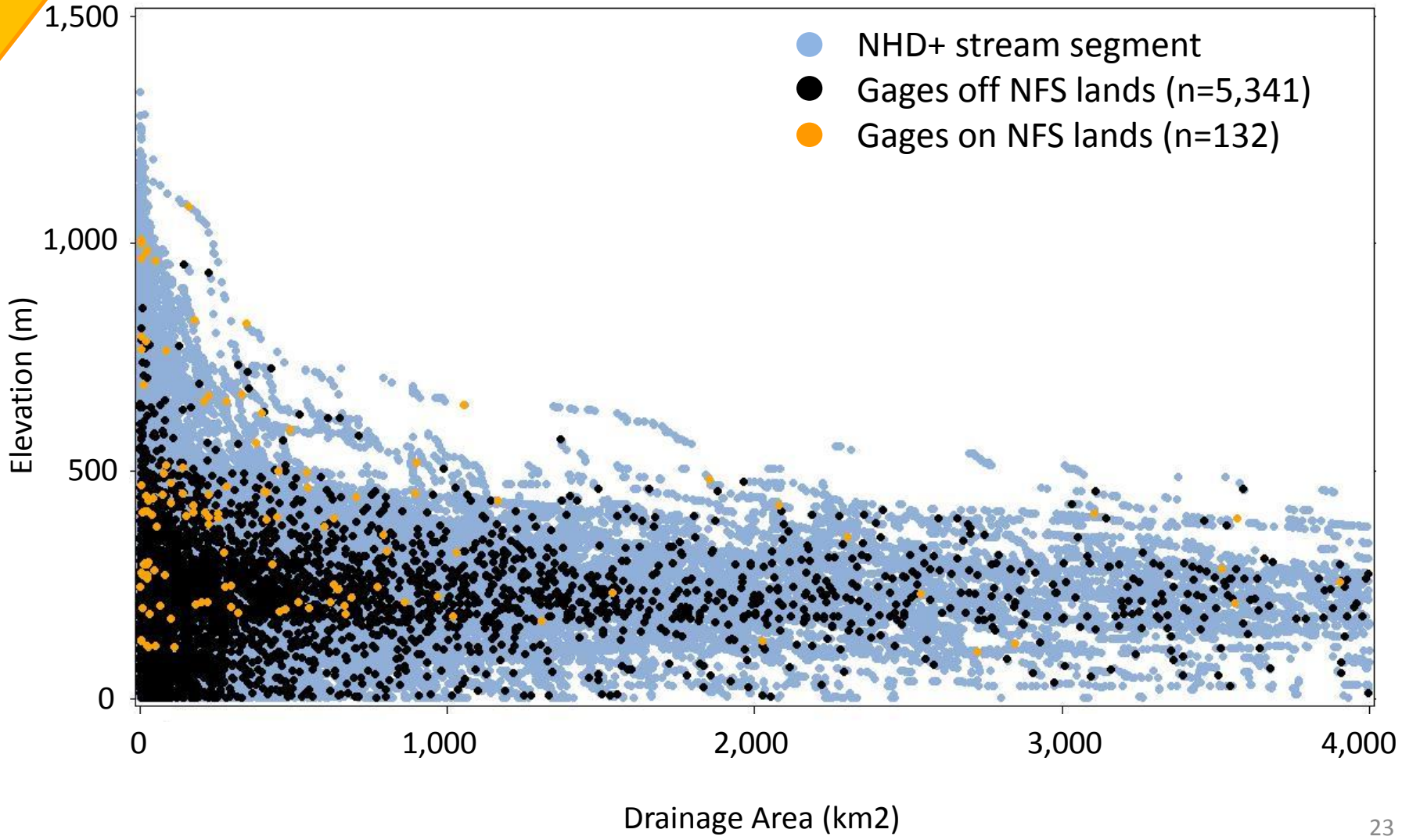

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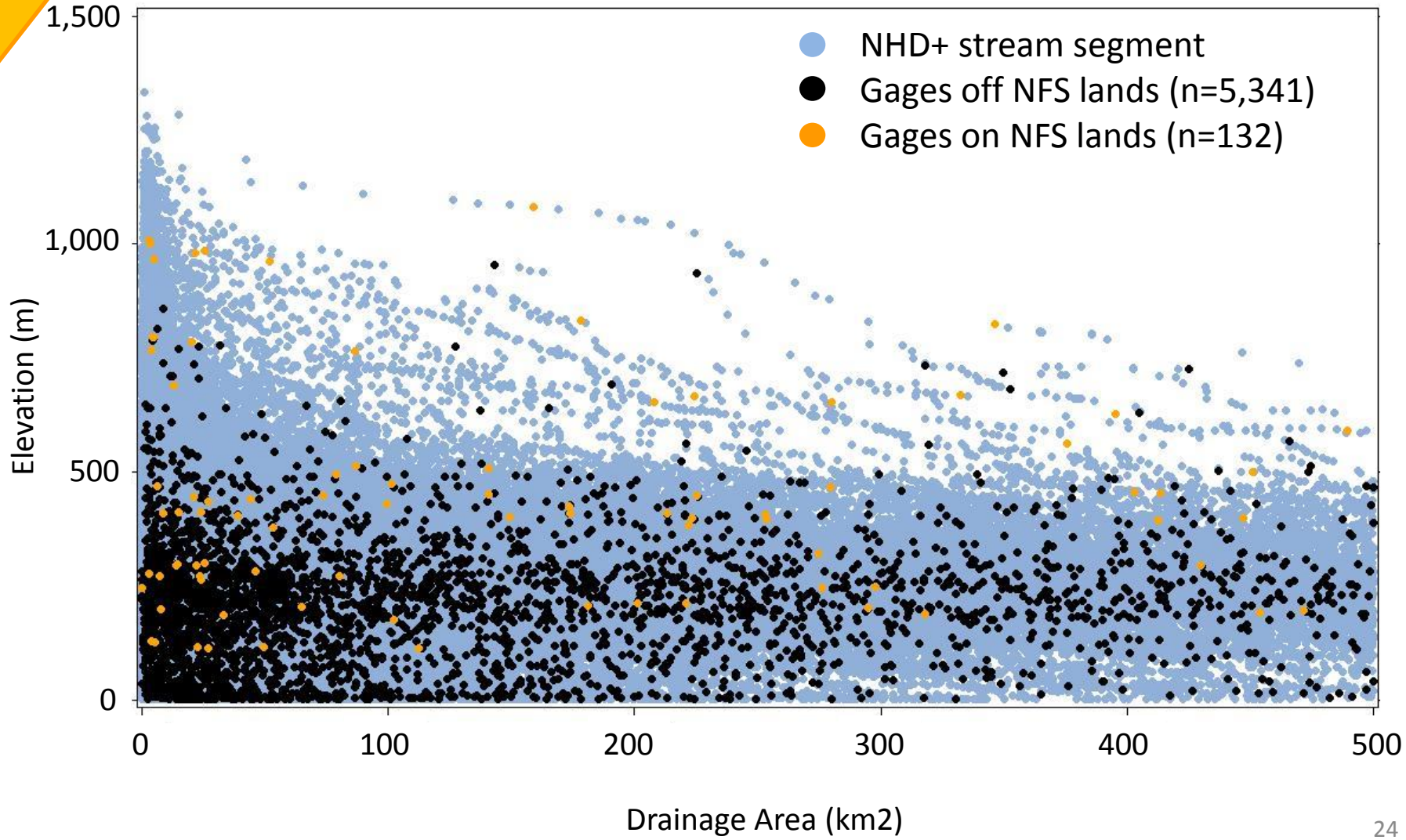
All Stream Gages – off and on NFS Lands



Group 3

Current Stream Gages – off and on NFS Lands

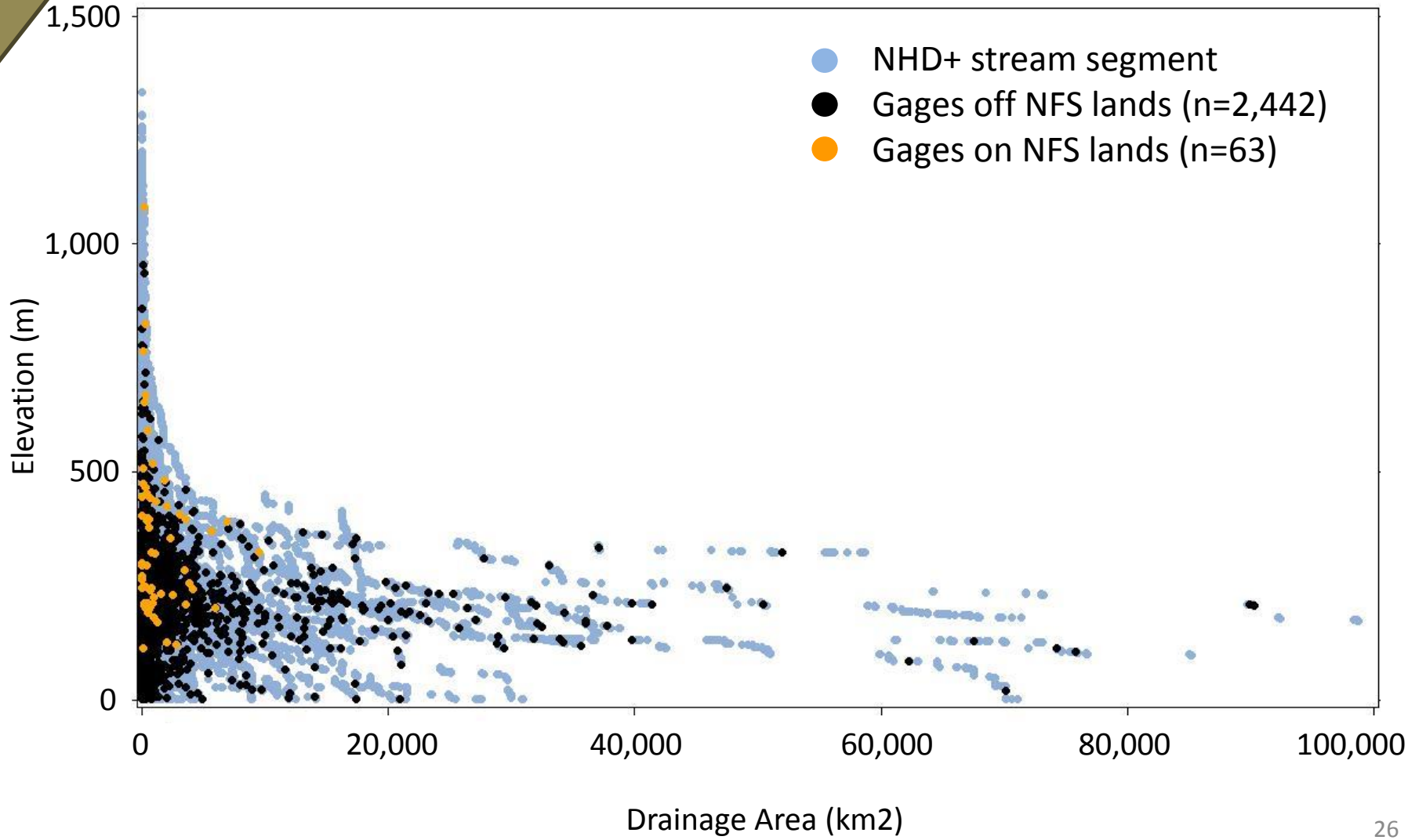
On the following 3 slides, each stream segment within Region 9 is plotted by elevation and drainage area (truncated at 100,000 km^2).

Overlaid on the stream segments are the 2,505 stream gages that are currently operational, as of January 2010. There are 2,442 gages operating off NFS lands and 63 gages on NFS lands.

The only difference between the next few slides is that for each successive slide, the horizontal axis will be magnified, as before.

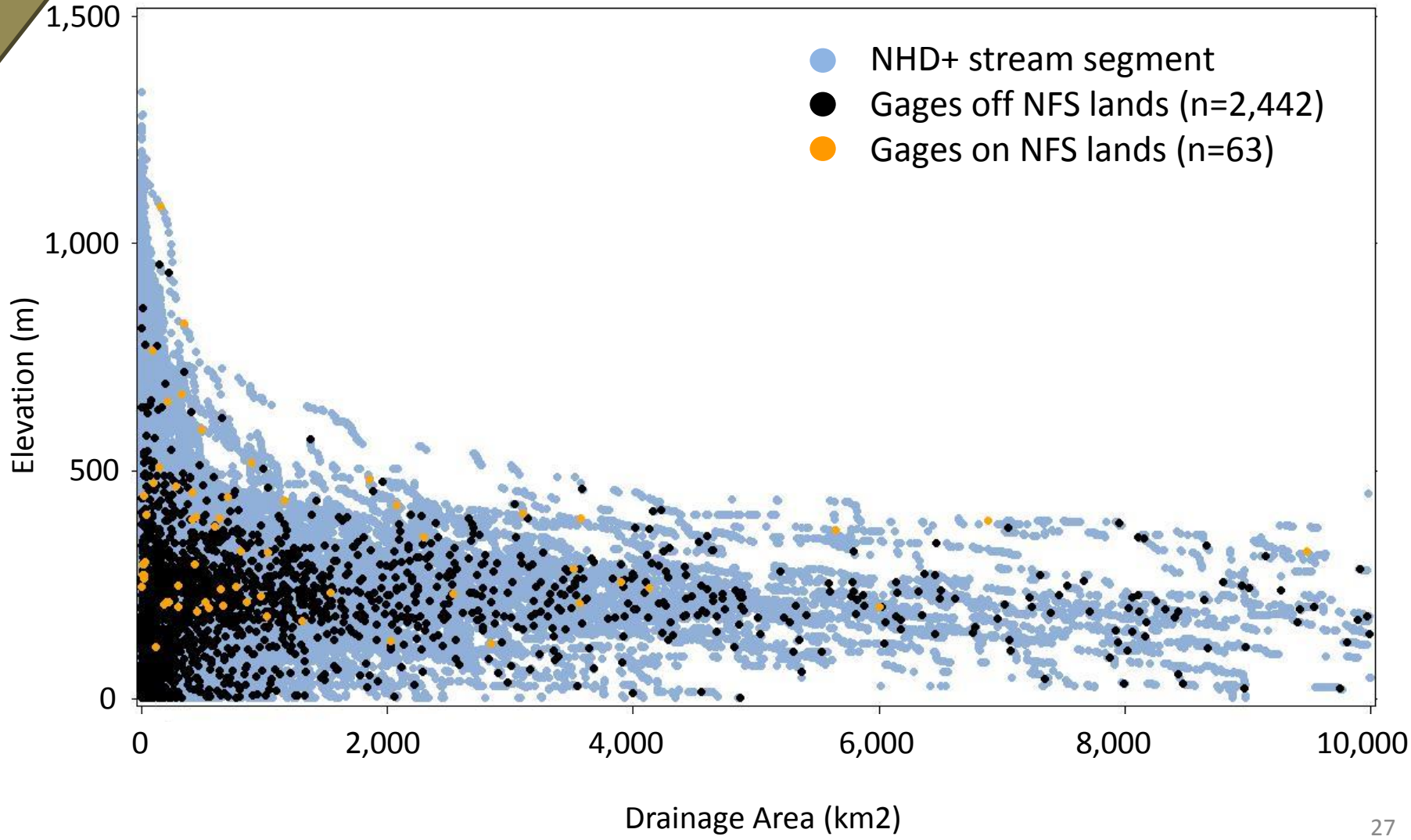
Group 3

Current Stream Gages – off and on NFS Lands



Group 3

Current Stream Gages – off and on NFS Lands



Group 3

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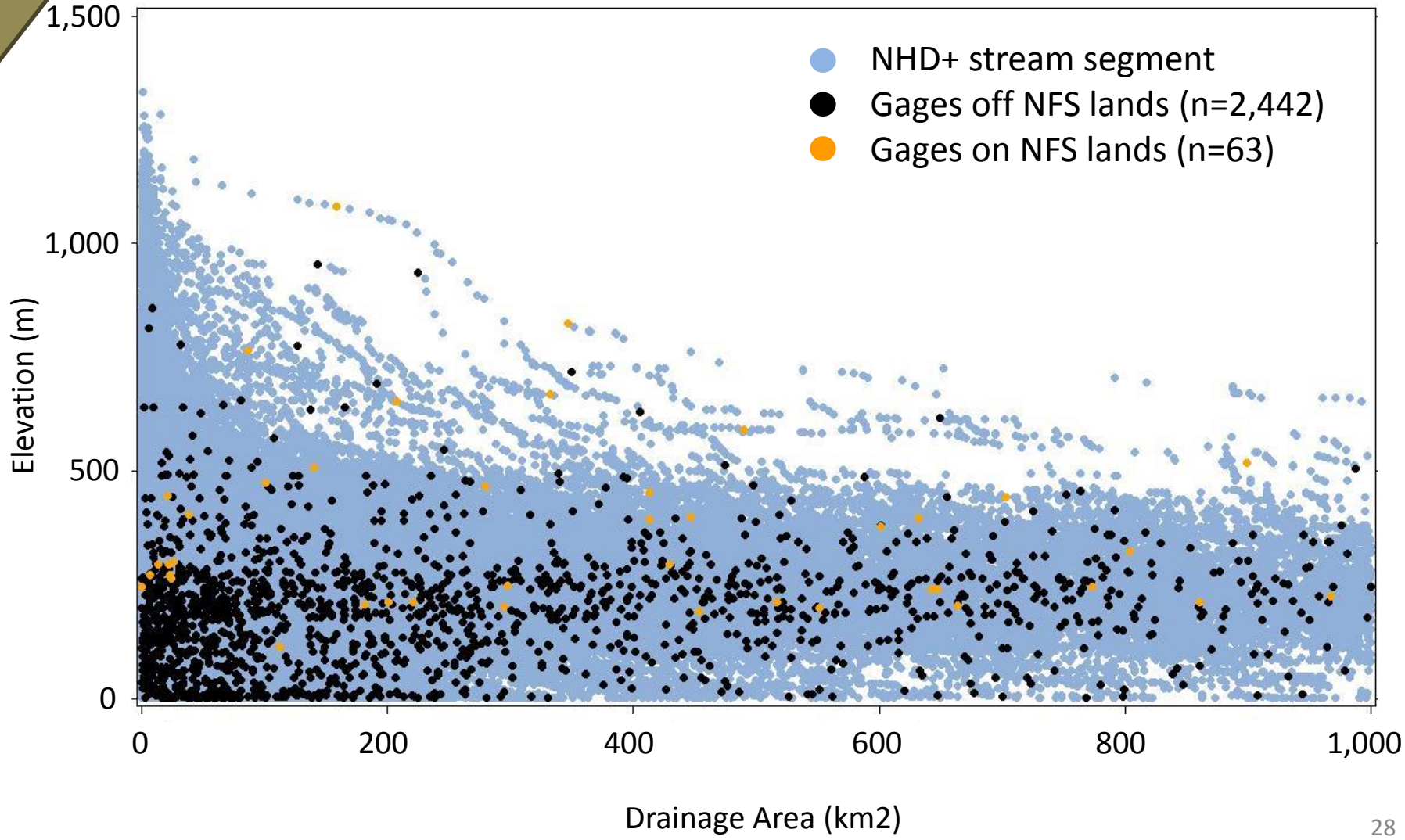


Group 4

Group 4

Streams and Historic Gages on NFS Lands

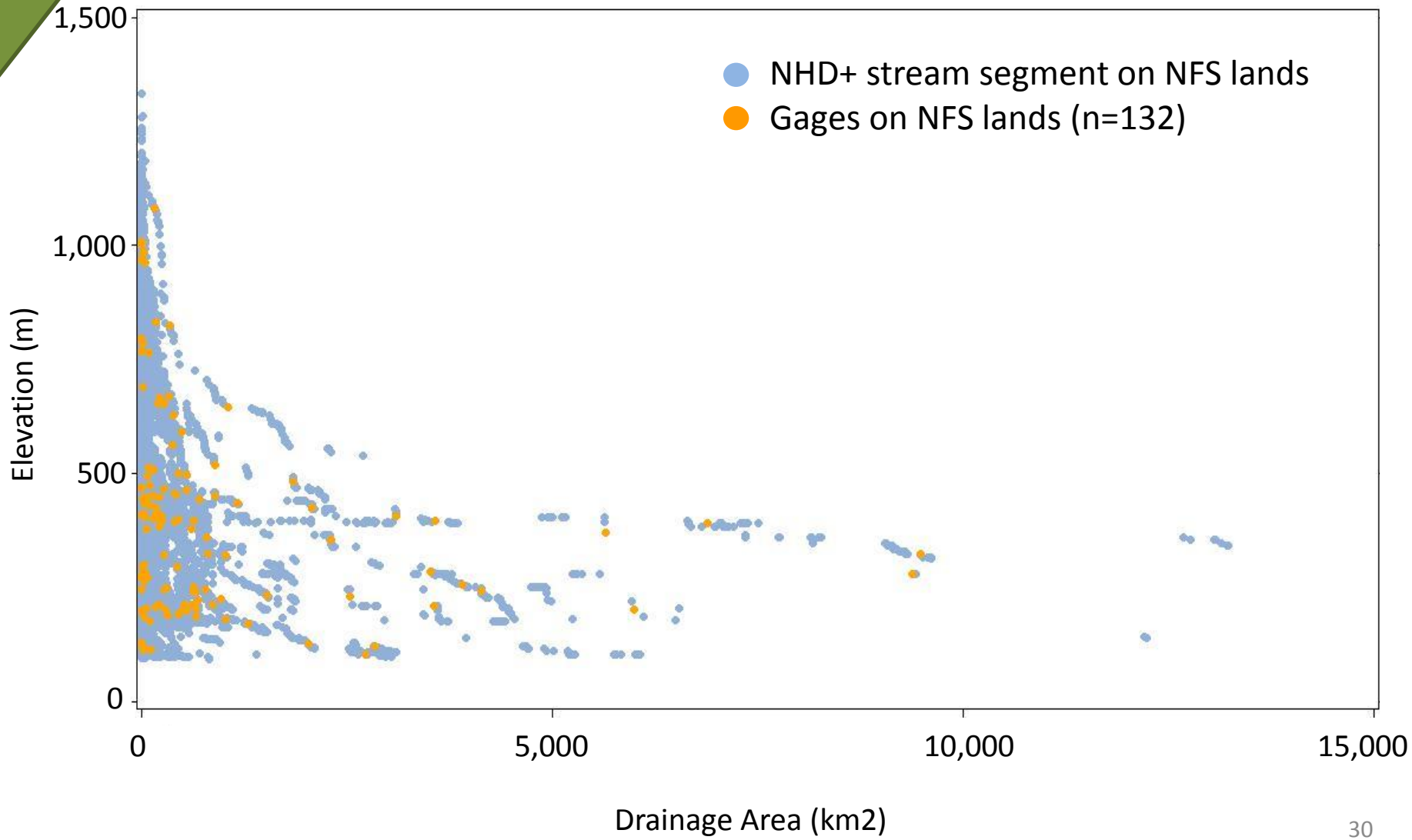
On the following 3 slides, we have plotted only the stream segments that are on NFS lands. Overlaid on the stream segments are 132 stream gages that are/were active since 1912.

These slides allow us to see the available population of stream segments, relative to the distribution of gages that occur on the Forest, versus Group 2, which showed all stream segments in the entire region.

The only difference between the next few slides is that for each successive slide the horizontal axis will be magnified.

Group 4

Streams and Historic Gages on NFS Lands



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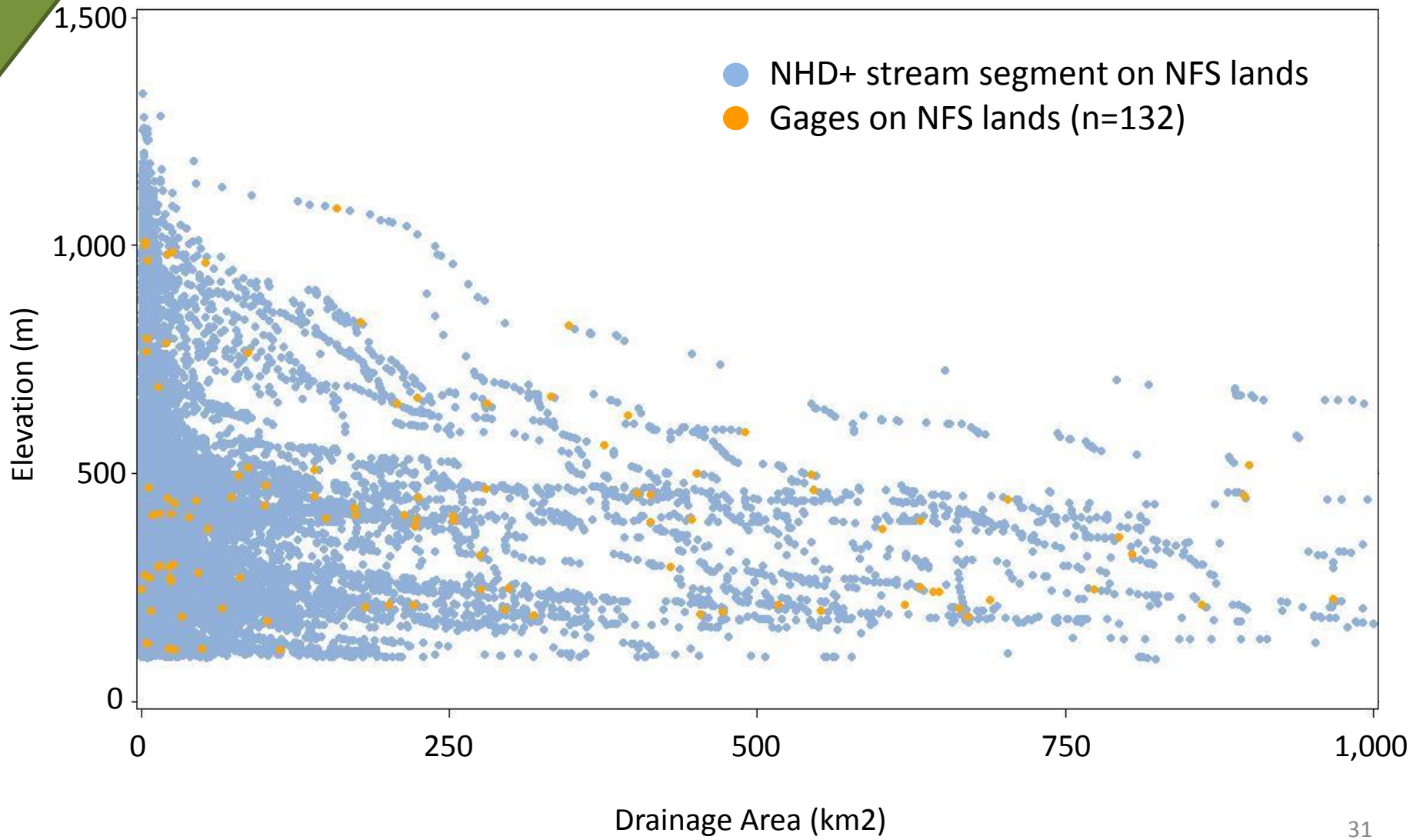
Streams and Historic Gages on NFS Lands



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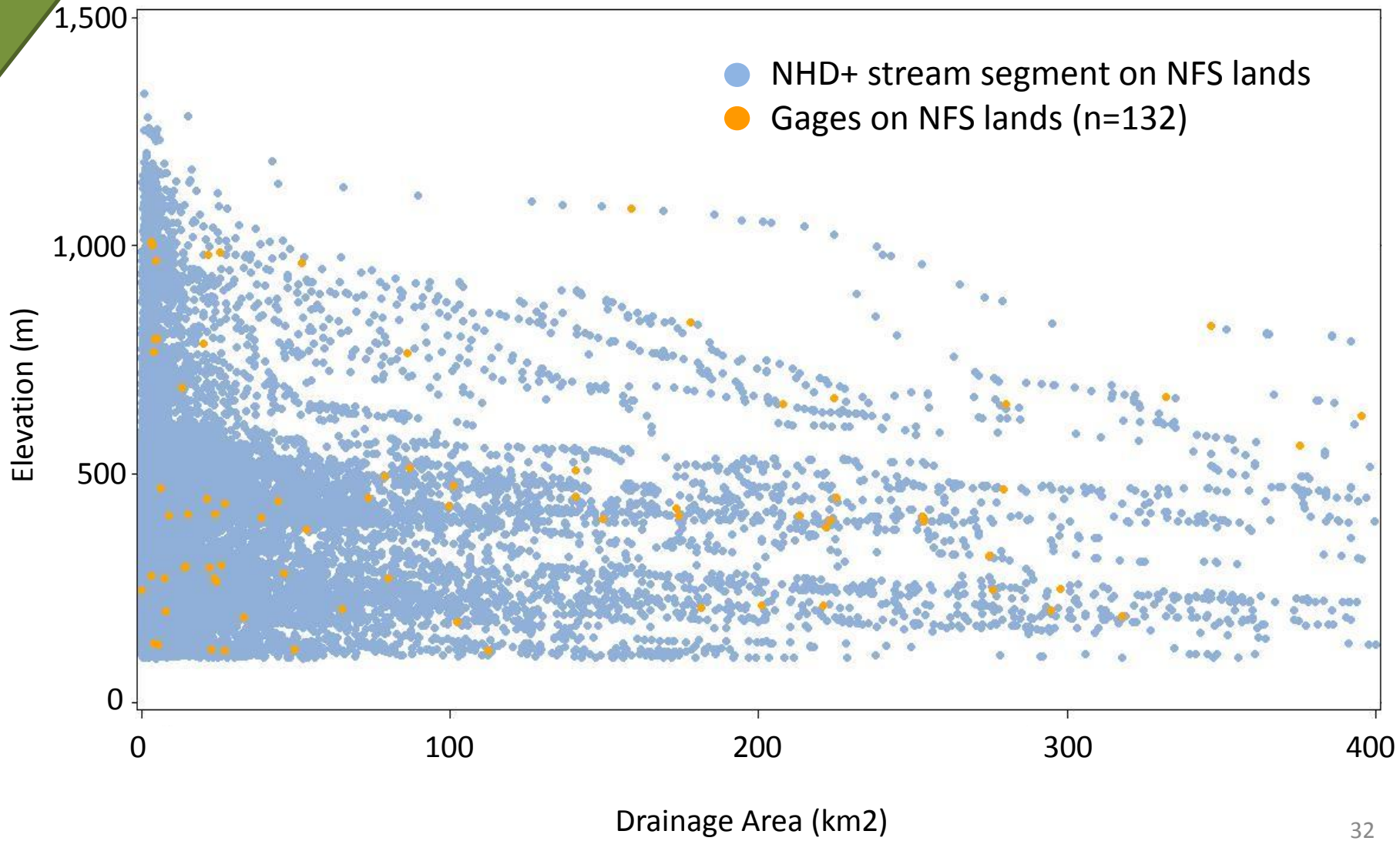
Streams and Historic Gages on NFS Lands



Group 5

Group 5

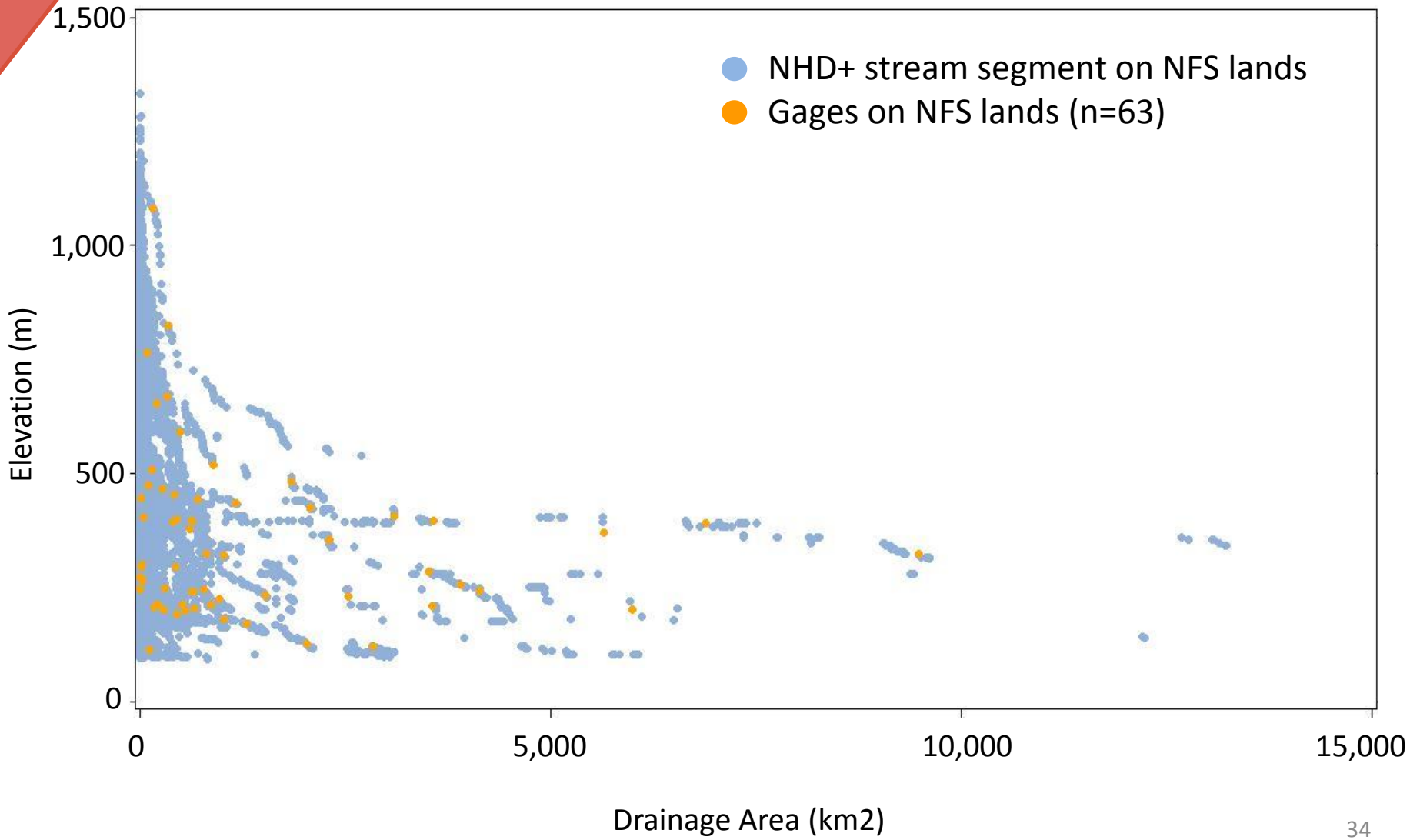
Streams and Current Gages on NFS Lands

On the following 3 slides, we have plotted only stream segments that are on NFS lands. Overlaid on the stream segments are the 63 stream gages that are currently active as of January 2010.

For each successive slide the horizontal axis will be magnified.

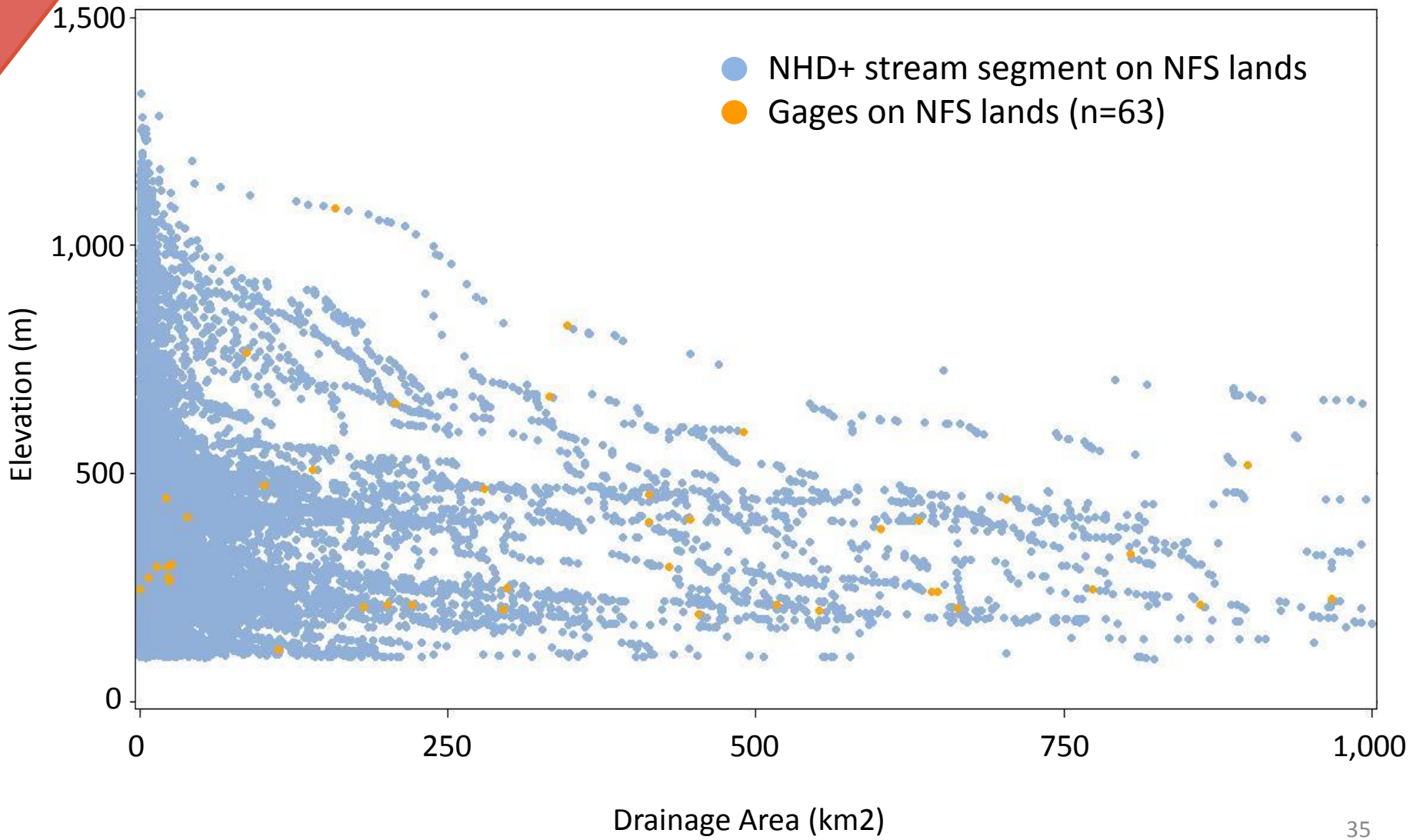
Group 5

Streams and Current Gages on NFS Lands



Group 5

Streams and Current Gages on NFS Lands



Group 5

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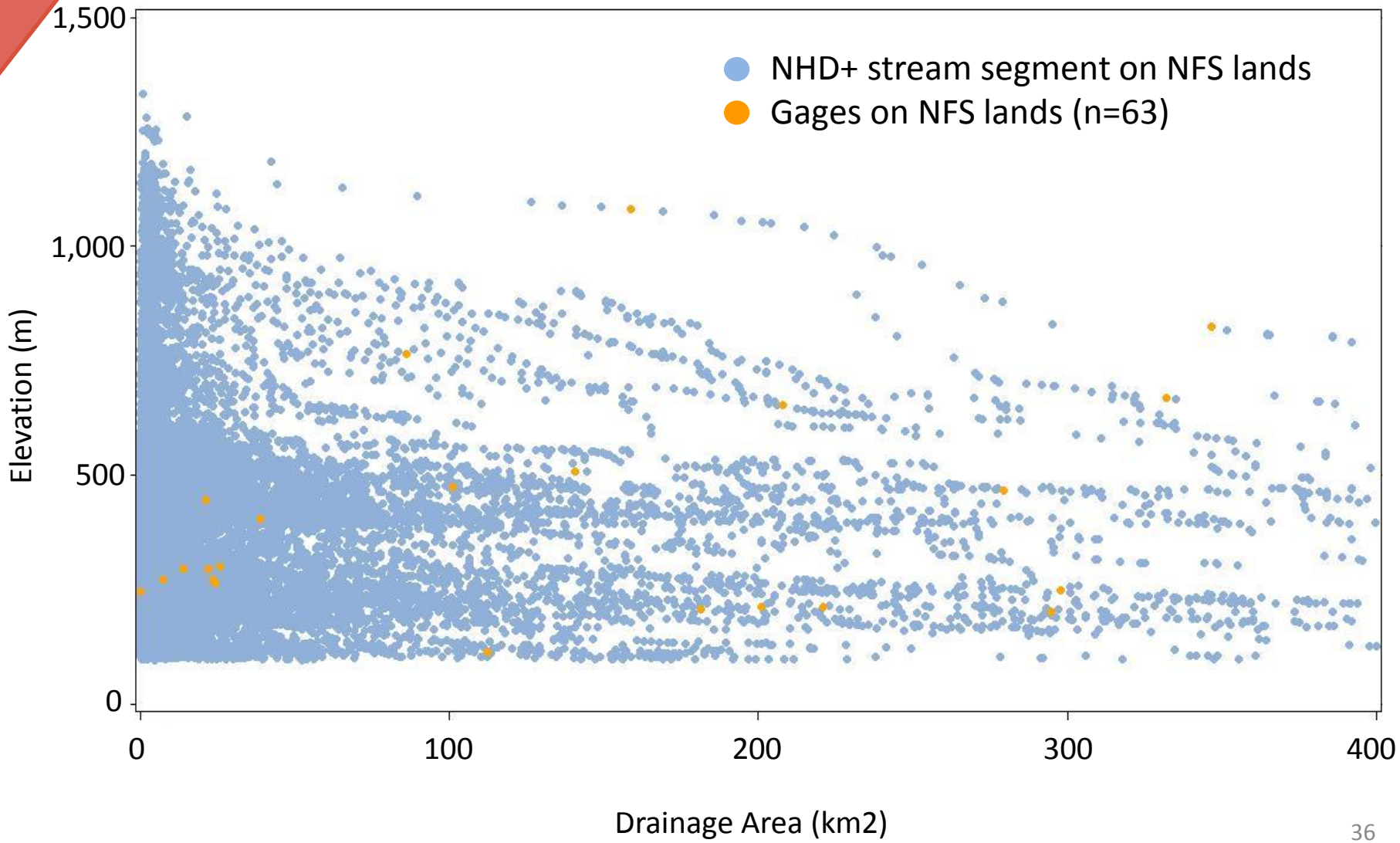


Stream Gages Adjacent to NFS Lands

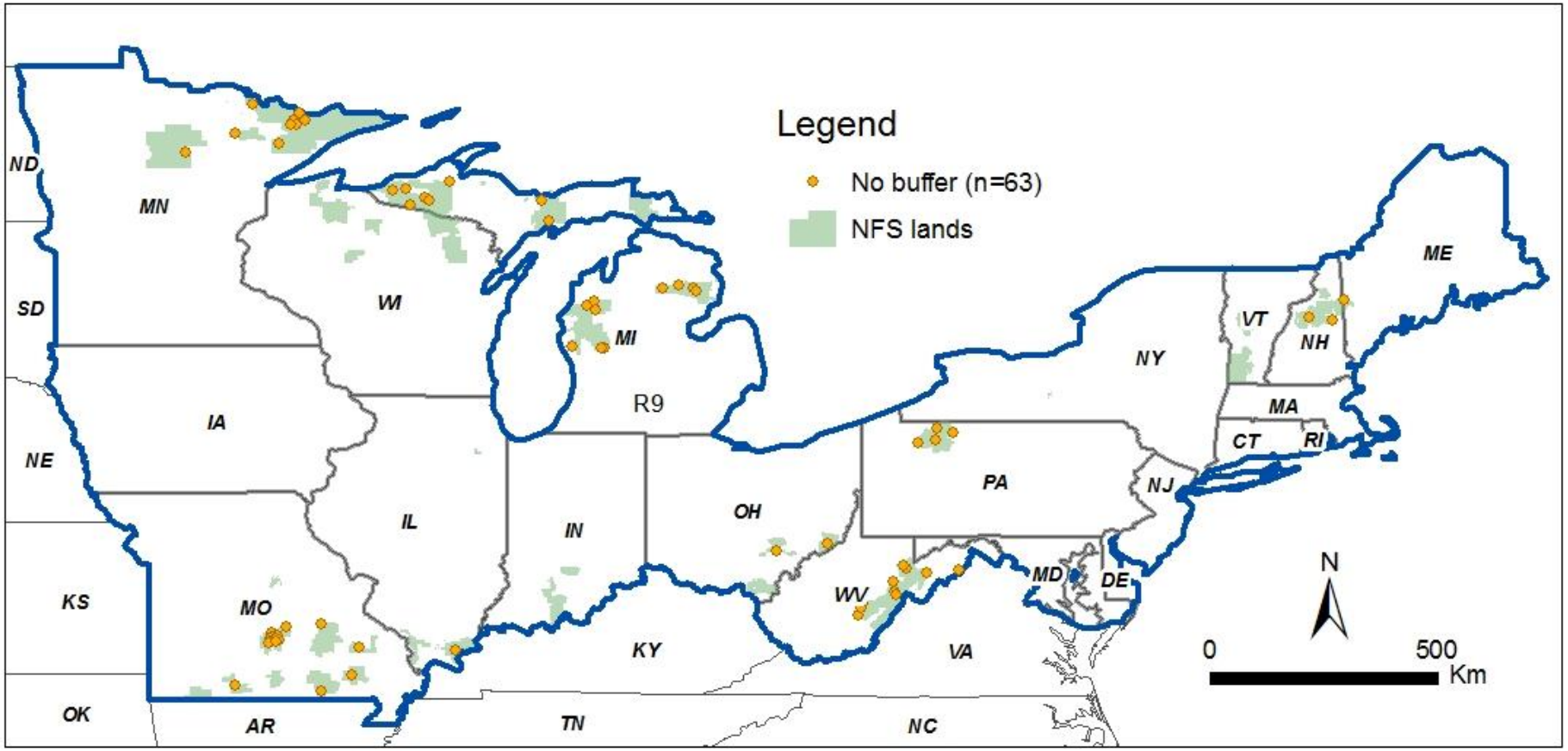
ISSUE

Many stream gages are located on waterways that are downstream of, and not on, a National Forest. In our analysis, only streams gages that touched a Forest boundary, using ArcGIS, were classified as a gage on NFS lands. This type of classification does not account for the tremendous amount of flow that influences gages immediately downstream of a Forest.

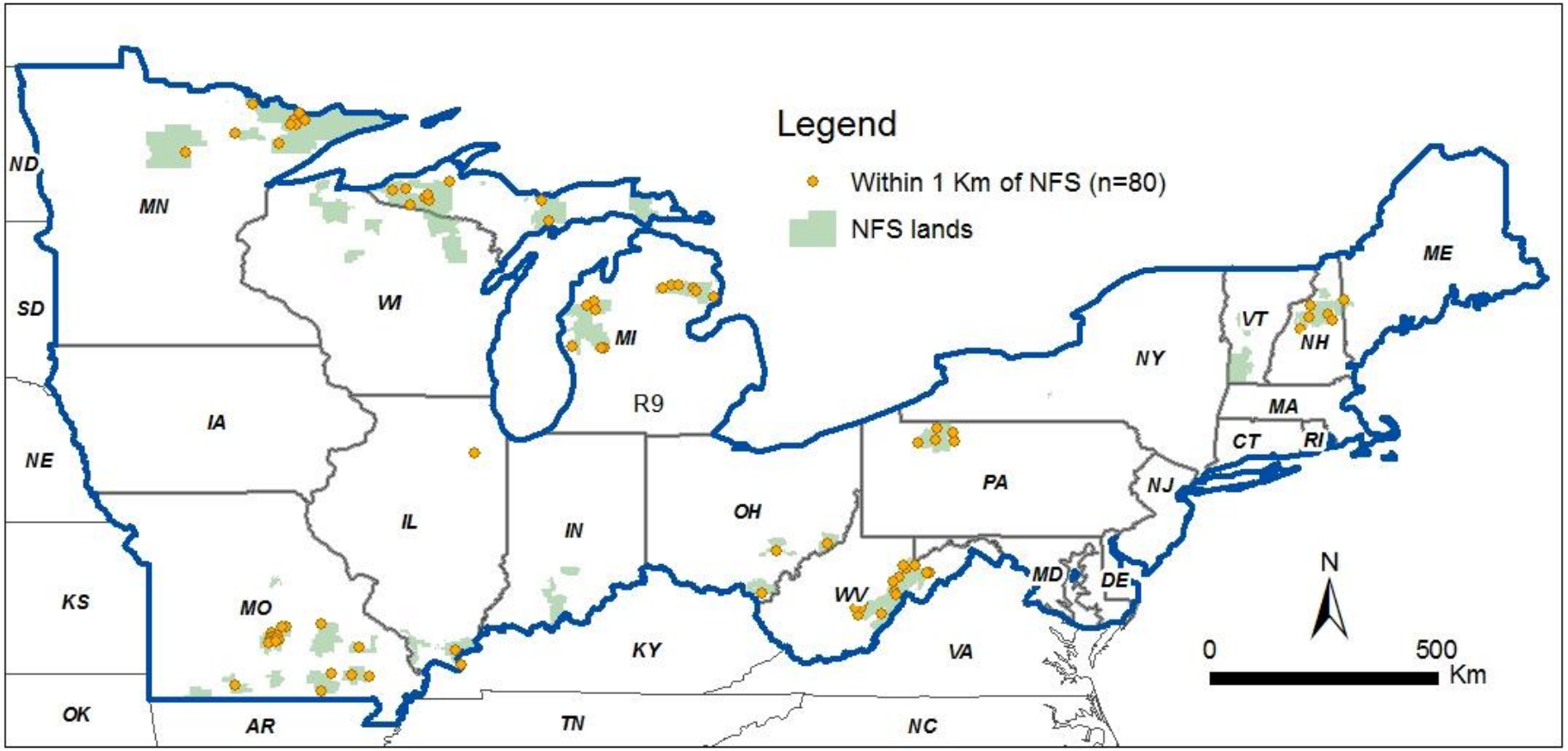
SOLUTION

On the next 6 slides we show the effect of adding a 1 Km and 10 Km buffer around the Forest boundary. We classified all gages within the buffer as being on NFS lands.

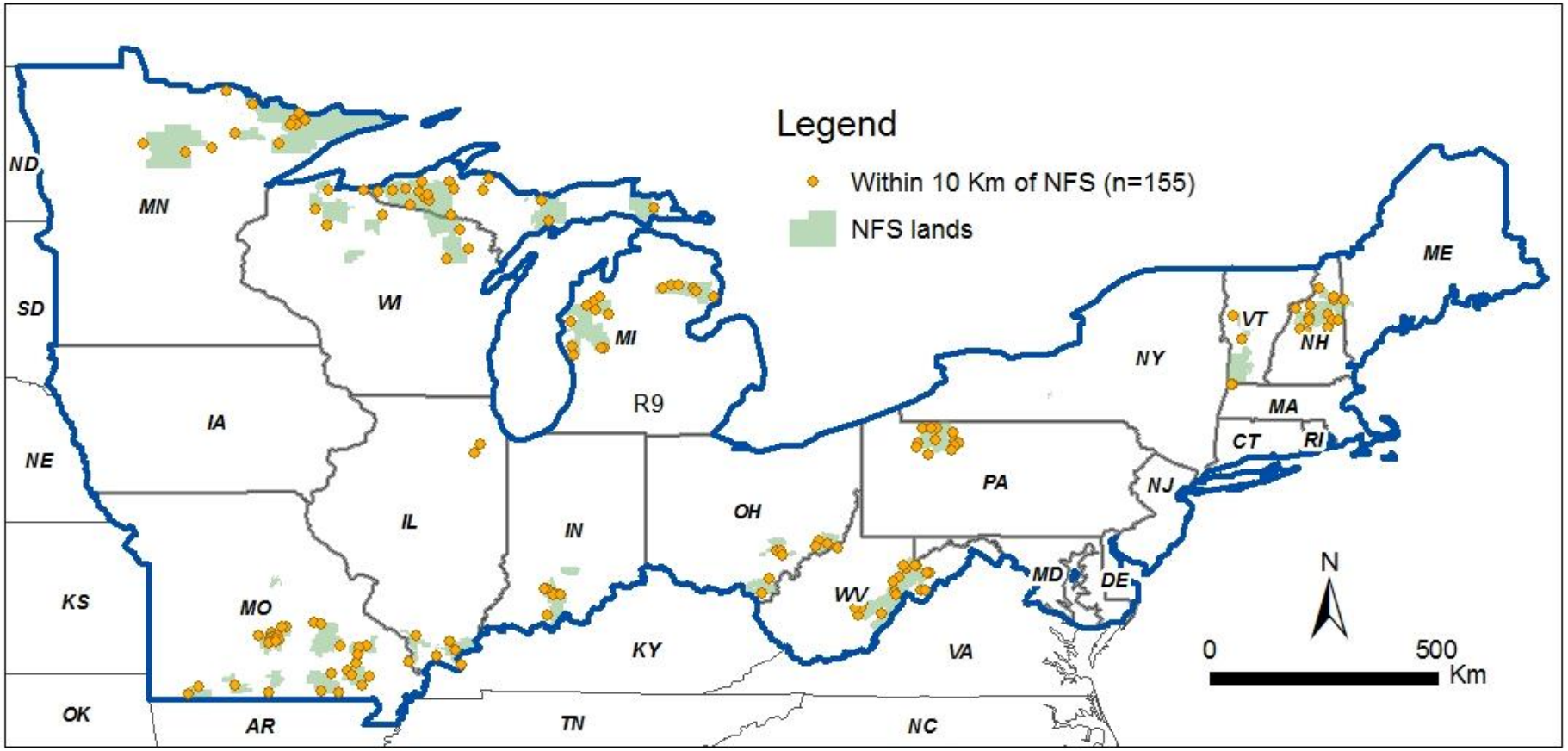
USGS Stream Gages Currently Operational: On NFS Lands – **No Buffer**



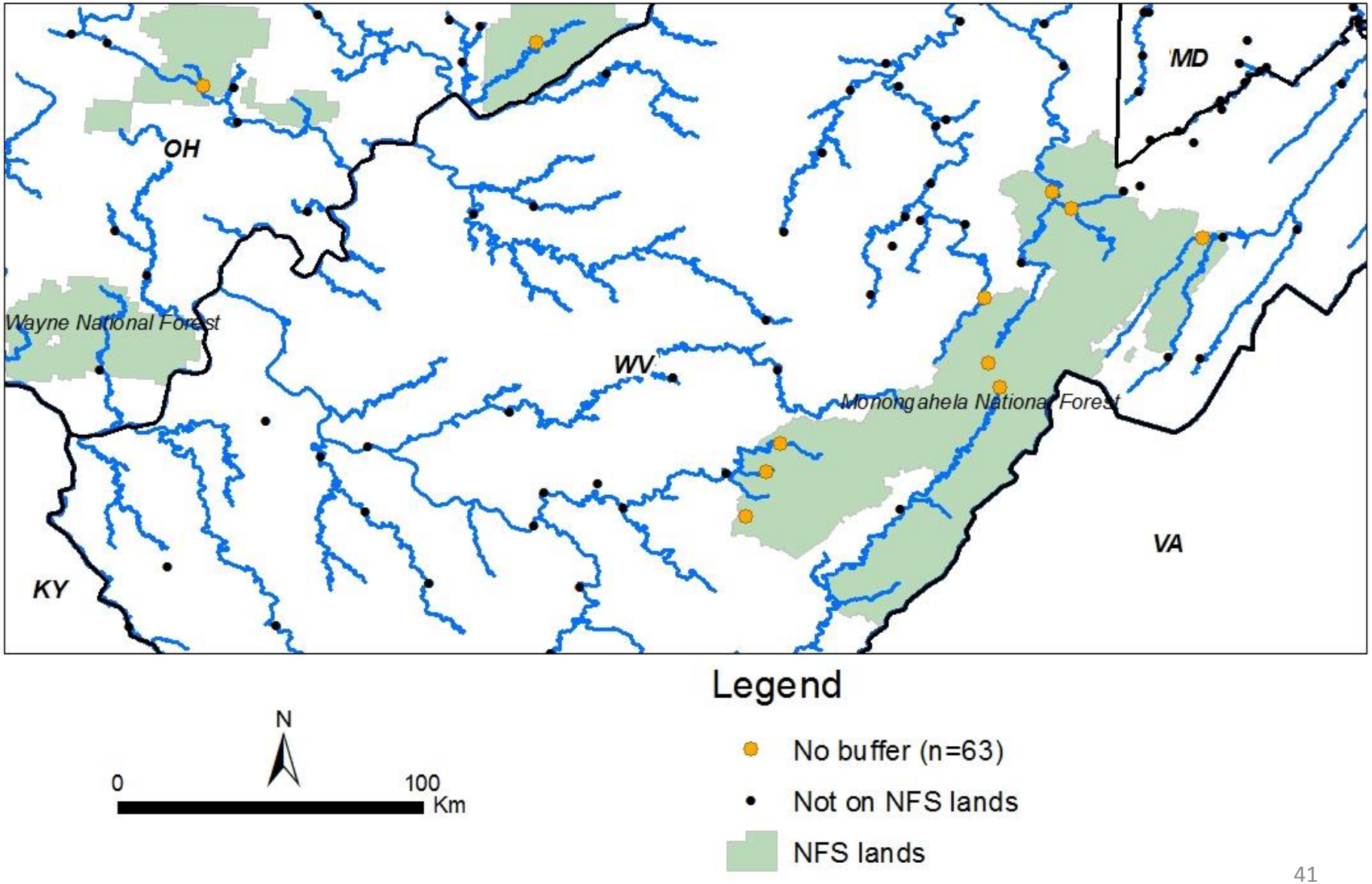
USGS Stream Gages Currently Operational: On NFS Lands – **Within 1 Km**



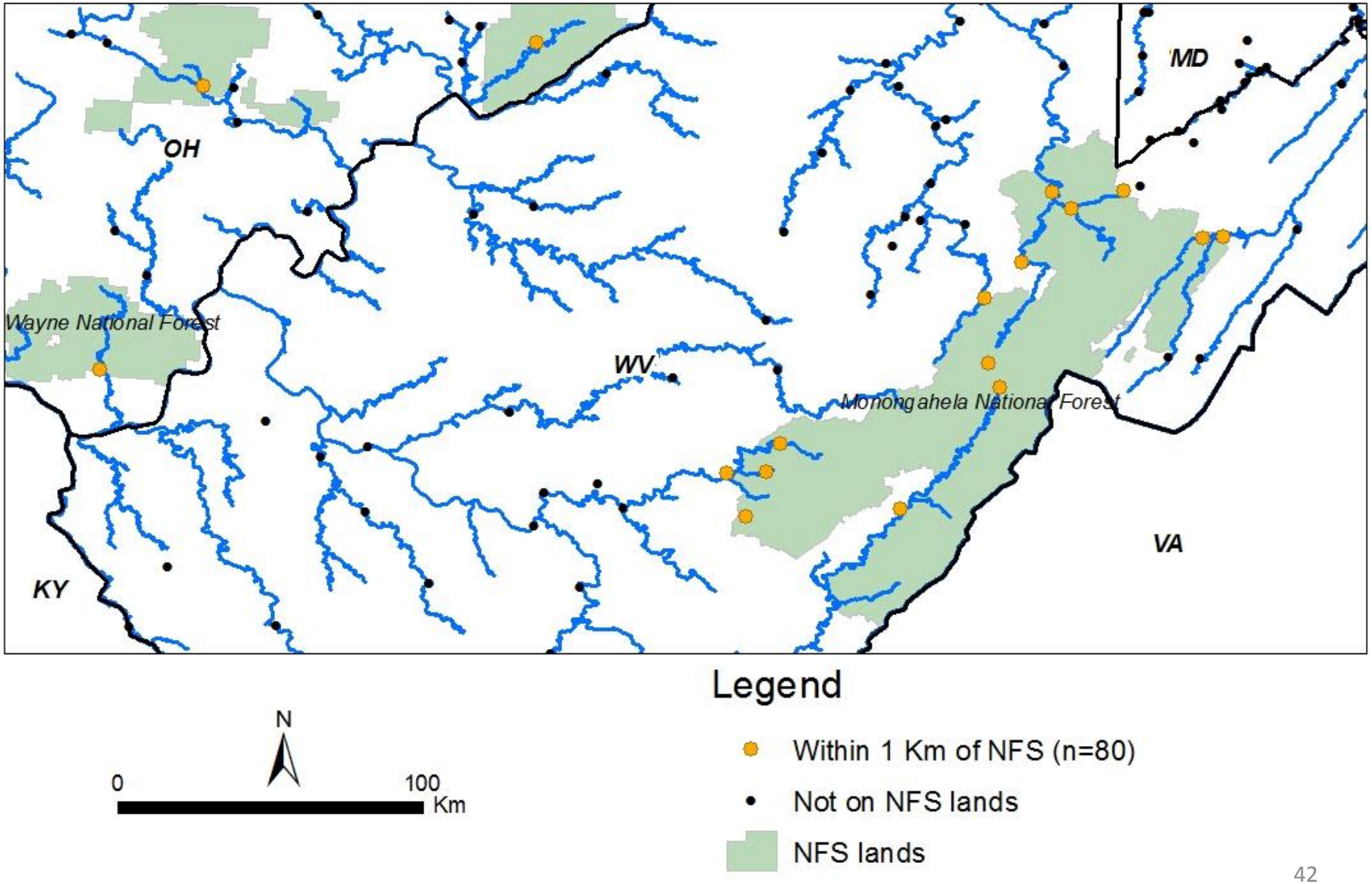
USGS Stream Gages Currently Operational: On NFS Lands – **Within 10 Km**



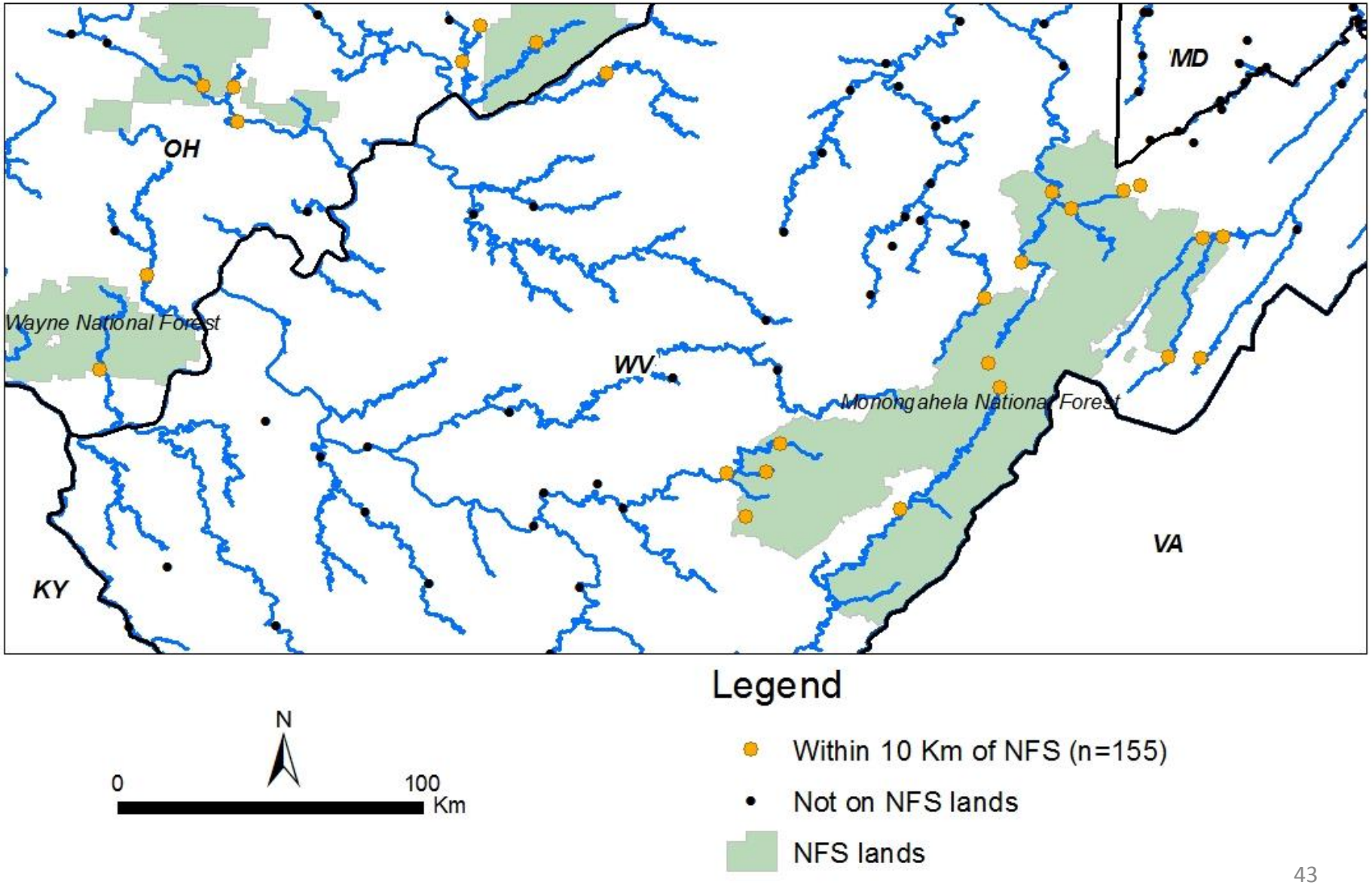
USGS Stream Gages Currently Operational: On NFS Lands – **No Buffer**



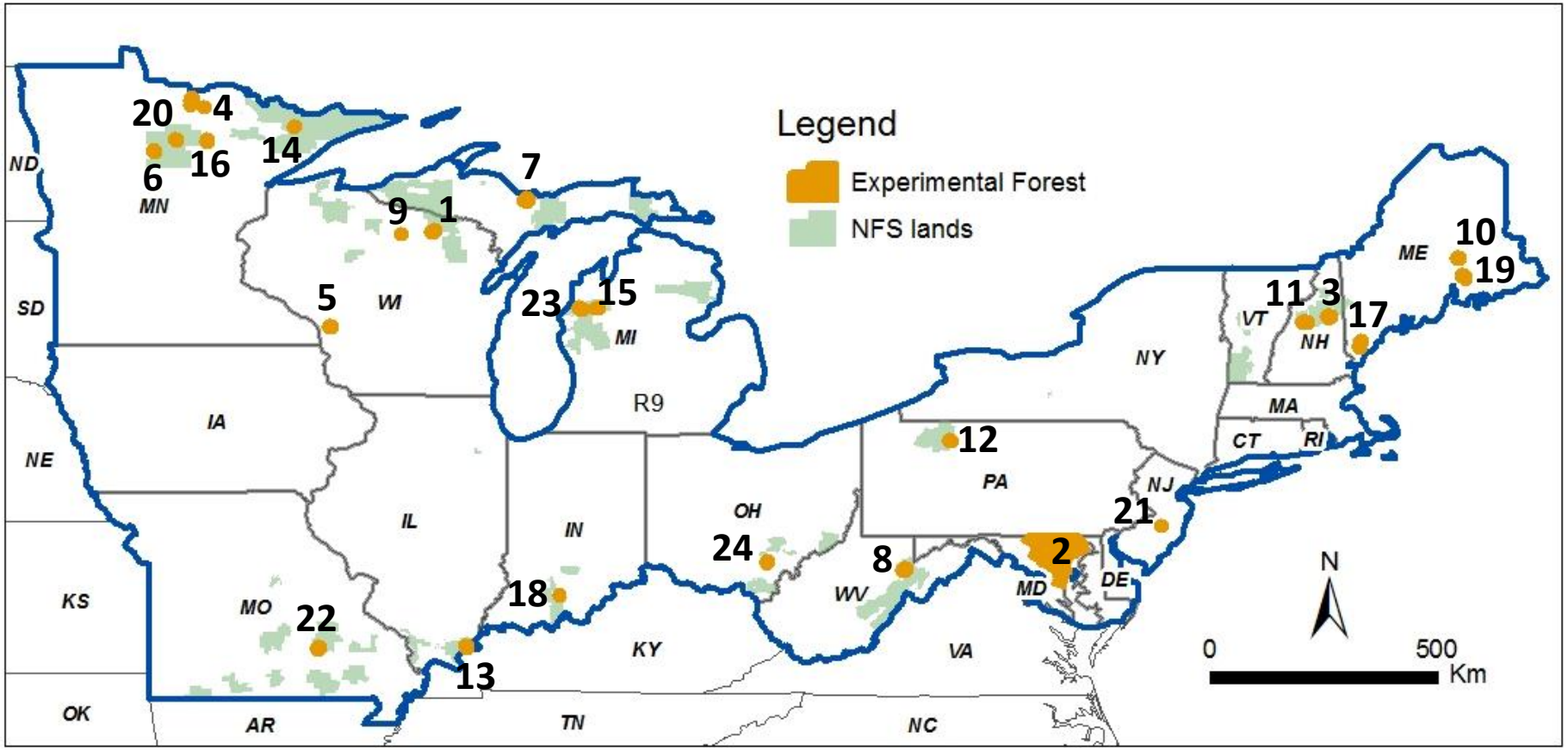
USGS Stream Gages Currently Operational: On NFS Lands – **Within 1 Km**



USGS Stream Gages Currently Operational: On NFS Lands – **Within 10 Km**



Experimental Forests in Region 9



1	Argonne	7	Dukes	13	Kaskaskia	19	Penobscot
2	Baltimore	8	Fernow	14	Kawishiwi	20	Pike Bay
3	Bartlett	9	Harshaw	15	Lower Peninsula	21	Silas Little
4	Big Falls	10	Howland	16	Marcell	22	Sinkin
5	Coulee	11	Hubbard Brook	17	Massabesic	23	Udell
6	Cutfoot Sioux	12	Kane	18	Paoli	24	Vinton Furnace

Mohawk River gage at Delta Dam, NY